
**COMPLEXITY THEORY AND APPLICATIONS TO MANAGEMENT: PRINCIPLES
REGARDING BUSINESS COHERENCE AND FLUENT OPERATIVE SYSTEMS
WITHIN ENTERPRISES**

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ABSTRACT

The main aim of this paper is related to discuss the importance of pertinent managerial practices regarding the principles of: (i) coherence in establishing management direction; and (ii) keeping up with timing operative systems within the context of entrepreneurial logistics. At the beginning, fundamentals of complexity theory are presented; based on these essentials, the contents of this paper is devoted to the implementation of the aforementioned principles and fundamental practices. Complexity theory can bring significant theoretical elements concerning spheres of planning, organization, factor's endowment, operations and activities' assessment for management of units of production or enterprises.

Key words: Complexity theories, management direction, supply chain management.

JEL Classification: D02, D03, D23

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**TEORÍA DE LA COMPLEJIDAD Y APLICACIONES A LA ADMINISTRACIÓN:
PRINCIPIOS SOBRE LA COHERENCIA Y LA FLUIDEZ DE SISTEMAS
OPERATIVOS EN LAS EMPRESAS**

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RESUMEN

El objetivo fundamental de artículo es discutir la importancia y puesta en práctica de mecanismos operativos relacionados con: (i) coherencia en la dirección de política empresarial; y (ii) de mantenimiento de los flujos de operaciones dentro de las organizaciones o empresas. Se abordan inicialmente aspectos esenciales de la teoría de la complejidad. A partir de ellos se determinan directrices para operativizar los principios y prácticas antes referidos. La teoría de la complejidad puede brindar elementos muy valiosos para la planeación, organización, dotación de recursos, operativización y control de las actividades de empresas o unidades de producción.

Palabras clave: teoría de la complejidad, dirección empresarial, flujo de operaciones logísticas.

Clasificación JEL: D02, D03, D23

CORE THEORETICAL ASPECTS OF COMPLEXITY THEORY: REFLECTIONS ON GENERAL MANAGEMENT

One of the main features of the complexity theory (TC) is that it allows a useful conceptual framework for dynamic and flexible analysis which in turn would be effective for carrying out more comprehensive studies. Units of reference might be companies, actors within the company -with different hierarchical levels in office: senior management, senior management, middle managers and operational staff-management related flows; in addition to flows of information exchange and specialized personnel, financial resources and commercial links, belonging to business networks (Bourne, 2007; Cooke-Davies, et.al., 2007; Johnson, 2004)².

Based on the aforementioned concepts, one can develop, with the use of CT, diagnostics and more specific and reliable forecasts in terms of: (i) social behaviors and psycho-social, (ii) the development and behavior of networks; and (iii) major organizational and functional procedures related to the formulation, implementation and evaluation of plans, programs and projects.

All these features can be link to (i) small or medium-production units whose performance is related to more rotation rates of inventories; and (ii) big companies and more complex projects -those that usually base their perdurability on solvency indicators, which include fixed assets.

One of the fundamental principles to keep in mind in the application of CT is that the practical conditions require much simplicity as possible and as much complexity as needed.

In this regard, a more specific application, for example, is that, the greater complexity of the systems, the greater the tendency to generate entropy, that is a more disordered environment³.

In this regard, one of the evidences is related to the ecological damage that current economic systems are producing at planetary level. Not only is pollution, but associated with this phenomenon is the waste of resources,

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2. Several theoretical approaches have been written in reference to complexity as the main level or category, which include, from an epistemological perspective, structural thought and systemic approaches. This last category in turn includes endogenous factors and exogenous elements as well; more discussion, Wilson 2003; Goldberger, 1996; and Varela, 1991.
 3. In terms of ecological issues it is necessary to point out damage for ecosystems. One of the most remarkable condition is the fiscal penalty mechanism for negative externalities. A key component here is the ownership of resources and the fact that natural resources can be of a renewable or non-renewable nature. Renewable resources are appropriated ones more likely or easily object of fiscal penalty; more conceptual elements in Waldrop, 1992; Pollak, 2007; Malloch, 2007 and Cooke, 2007.

loss of species and renewable natural systems, plus the amount of food that finish in garbage (Pollank, 2007; Dublin, 1978; Sharp, 1995)⁴.

In the sense of the relationship between leadership and management, for the purposes of this document, the broader category is management. It would be split, on one hand, in the phase of direction that has links with external relations of the company, strategy and leadership concerns; and, on the other hand in the sphere of restrictive management. This later concept would include:

- Business 'columns: marketing, production or logistics and operations –might include here supply chain management, financial topics, human resources and organizational development;
- Platform management components: planning, organization, integration or resource allocation, management, operations management, control, or monitoring and evaluation and the identification and implementation of corrective mechanisms (Mochón, 2007; Malloch, 2004).

In addition to recognizing and applying the principles of CT, it is necessary to keep in mind specific aspects of the “temporary knowledge organizations” (CTO). Within this concept, important topics will include: attitude´s staff, organizational environment, motivation and driving factors, social capital and operational networks, both formal and informal; these issues can be crucial for enterprises´ performance and competitive capacities within market conditions.

All in all, the basis for the management of a company need to take into account the sequential processes and outcomes that are generated in the dynamic behavior of networks of actors either senior management, middle or personnel operational and / or connections between clients and competitors. That is, networks related to sub-systemic and systemic elements (Schon, 1983; Berwick, 1998).

It should also be noted that the principles and foundations of complexity theory are not unrelated to those of systemic and analytical systems of thinking. On the contrary, analytical or structural systems of thought are part

4. Based on these considerations, one can conclude that the problem of ecological sustainability beyond ideological considerations is a problem of the survival of human society, which must control excessive consumerism and the society “disposable culture”. While annually go to waste a total of 1,300 million tons of food, according to statistics from the most developed countries, equivalent to the production of cereals Saharan countries or one-third of all food occur- about 1,200 million of people endure chronically lack of food; see the organizational documents of the United Nations Fund for Food and Agriculture (FAO) (<http://www.fao.org/docrep/016/i2697s/i2697s.pdf>).

of the systemic logical approach; this systemic content is part of complexity theoretical theories (Stacey, 1996; Zimmerman, *et.al.*, 1998)⁵.

Systemic methods involve structural thinking and tends to refer to units of reference more related, more integrated and with more dynamic links, even if they are rather mechanical in their nature. These methods seek to establish components and relationships that characterized systems, whether links are fundamental or structural, or conversely more temporary or accidental ones (Restrepo & Rivera, 2008).

Concepts of CT, to say it again, provide a more specific way or method for studying phenomena. With this base, this paper devoted next section to characterized functional and organizational aspects of enterprises, which are vital elements for companies to carry out their productive activities for goods and services (Diesing, 2009; Brookes, *et.al.*, 2006; Langton, 1989).

ORGANIZATIONAL AND FUNCTIONAL ESSENTIAL COMPONENTS OF COMPANIES AND CULTURAL ELEMENTS: AN OVERVIEW

Both from the perspective of processes and from the standpoint of results, the components from which one can analyze the management phenomena are essentially four aspects:

- Identification of goals or purposes;
- Determining appropriate and dynamic functions based on objectives;
- Organizational features to perform functions, and
- Establishing hierarchy to run the organization.

This is the identification of key issues, which in fact are becoming more complex and specific to the extent that business and production processes demand further complication for the production of goods and services that belong to the core aspects of a particular company. The point to note here is general, later this paper will address particular elements of operational nature (Helligner, 2004; Echeverria, 2001; Day, 2004)⁶.

5. This dynamic scenario can usually be presented as one of “static equilibrium”. Normally it manifests in terms of formal hierarchies, but also based on informal groups that despite their nature, can have significant influence on functions and organization of companies. See: Bourne, 2007, Briggs, 1992, and Stich, 1990.

6. Here it should be considered three sets of issues: (i) goals or outcomes, which may include effects or externalities either positive or negative, (ii) factors, components of causality or vector axis and (iii) assumptions. It is considered here that both, administration and economy, while having scientific features, are also political exercises and practices. In enterprises one can realize of a confluence or convergence of business management, microeconomics, and industrial engineering disciplines, see Portes, 2007; Restrepo and Rivera, 2008, and Todaro, 2005.

In a general perspective, functional performance at different levels within organizations, are influenced by dynamic cultural elements. From this view it can be said that in Latin America mainly derived from the legacy of Spain and Portugal, generally evidenced the predominance of the “culture of formal hall”. What matters is the submission of form or external, features. The prestige is often associated with the “ancestry” of families, especially those related to political power or social influence of ancestors that have been involved.

In terms belonging to the Anglo Saxon culture, behavior is more influenced by the European Enlightenment, forming social characteristics more based on “workshop culture”. As part of this concept it should be considered that, in general, Spain and Portugal would have been no widespread influenced of the Enlightenment, at least it is clear that those who came from the Iberian Peninsula to Latin America were not exactly the most illustrious ones, neither examples for ethical behavior to follow (Wilson, 1971; Stich, 1990; Holland, 1995).

The tendency of many companies pursuing on permanent basis of to rent-seeking, to the generation of easy money, fast and effective, is rooted in the historical origins from which Latin America emerged. One can find current examples of this situation regarding Latin American finance models, in extensive production patterns, in which capital accumulation procedures are based on low-income labor supply (Todaro, 2005, Portes, 2007; Rasiah, 2009)⁷.

All these conditions have resulted in the reduction of the internal market demand within economies, in general, of Latin American countries, therefore limiting forces which can drive domestic production, given the preference for international markets; eve more under current conditions, in which “free market” agreements have been completed and implemented.

In these circumstances, economic systems refuse to use sub-systemic demand from countries as driving forces of production and business innovation. This has fit with the approach of neoliberalism which has been based on: (i) decrease in progressive taxation, (ii) privatization of public

7. These aspects are mostly related to the macroeconomic level. Political viability for neoliberal measures was reinforced by the pressure of interest groups associated with large corporations. In that way it strengthened the promotion and establishment of economies based on financial links, which take resources from the real economy, thus reducing the capacity to produce goods, services and employment. It came also to dismantle the capacity of welfare states and thus leverage social nets or social supports for the most vulnerable sectors; further discussion of theories concerning economics of development in Todaro, 2005.

enterprises, (iii) deregulation, and (iv) outsourcing from government institutions to private companies (Kolb, 1984).

In many cases rent-seeking private companies in Latin America are supported and strengthened by traits of governmental mismanagement, deviation of resources and open cases of corruption. These elements are dynamic ingredients that lead to erratic growth patterns that promote inequality, poverty and maintaining factors against sustainable competitiveness of a country (Stacey, 1996).

Factors which promote economic growth, social wellbeing and development potential of countries, competitiveness, may favor the generation of productive growth and sustainable social development. All these factors are essentially related to: (i) political stability, (ii) macroeconomic stability, (iii) culture of work and effort, (iv) economic infrastructure, (v) education and training, human infrastructure, and (vi) effective rule of law and institutional conditions (Todaro, 2005)⁸.

By relating concepts of the influence of cultural elements, with the essential aspects of the functional organization of enterprises, trends are characterized by two general features. In societies influenced by the culture of the workshop, the emphasis is focused on the achievement of objectives and functions to carry out those aims. The organization and hierarchy are established as means in terms of activities and the achievement of goals or purposes (Schafer, 1976).

In a culture that lacks the impact of the Enlightenment, comes from the influences of the Middle Ages, modernity manifests as misleading scenarios or fake modernity at the beginning of XXI century. In this culture which emphasis formal presentation and “abolengo” or ancestry of families, the social scenario is more focused on organizational hierarchies often considered as ends in themselves. They tend not to give the importance of achiev-

8. Three works would be useful in this regard. The first two of the same author: Watson, Peter (2011) *Historia de las Ideas*. (Bogotá, Colombia: Taurus) Watson, Peter (2010) *Historia Intelectual del Siglo XX*. (Bogotá, Colombia: Taurus). The other work is Barzun, Jacques (2008) *From Dawn to Decadence*. (New York: Harper Collins). They show historical accounts of the influence of the Enlightenment as the culmination of Renaissance revivalism that comes to the sciences and the French Revolution. One of the most notable achievements is the Encyclopedia. It is the substitution of teo-centric approach for belief in science, the art, the effort and that work can constitute a set of effective means for solving problems. In general terms, that influence did not affect Spain. Barzun, for example in chapter 8 of his book, devotes a extensive discussion of the strategic positioning of Venice as a key city of the eighteenth century.

ing aims and objectives, and to functional conditions as well (Thamheim, 2007, Roberts, 1998).

Hence the tendency is characterized by forming societies with high degrees of dysfunctional features, where the levels of hierarchy and command, in the plot of profiteering, can lead to unsustainable development and economic growth scenarios.

ORGANIZATIONAL COHERENCE AND OPERATIVE SYSTEMS IN ENTERPRISES

In particular, essential directions within organizations are aimed to allow operational fluency based on enterprise platform components: planning, organization, integration or resource endowment, execution, control or assessment, identification and implementation of corrective mechanisms.

This would be supported by the functional columns of business regarding marketing, production, operations and logistics, financial issues, human resource management and organizational development (Holland, 1995, Mandelbrot, 1999)⁹.

All these conditions exist in the context of specific aspects of management: leadership, strategy components and external relations, that is, systemic elements of organization. These components are related to planning: goals and objectives, strategies, components and functional areas, to resource-management, project-planning, activities, actions and goals; which in turn are quantification of objectives or purposes (Briggs, 1992).

Taking into account what has been said now -the concepts of complexity, essential components of organic-functional, cultural influences towards organizations- functionality and organizational coherence require fluency regarding functions and operative systems; in this regard it is possible to identify three key aspects. They become increasingly critical as the functions and objectives of the organizations become more elaborated, diversified, more complex (Goldberger, 1996).

9. These conditions, functional and organizational aspects of companies, are related to leadership and management features. For example, administrative approaches in general may be directed to: (i) decision theory; (ii) quantitative mathematical approach; (iii) contingency or situational approach; (iv) administrative roles; (v) study of cases; (vi) social-cooperative practices; (vii) group behavior; (viii) overall quality; (ix) of the 7 "S's" of Kckinsey-strategy, including: structure, systems, style, staff, shared values and skills, (x) interpersonal behavior, (xi) reengineering, (xii) systems, (xiii) organizational development; see Koontz, Harold & Weihrich, Heinz (2012) *Management: A Global Perspective*. (Mexico: McGraw-Hill), especially Chapter I: Basis for Management Theory and Practice.

These three aspects that promote cohesion without compromising operational fluency are:

- Hierarchical centralization of corporate policies;
- Decentralization of operations and logistics, and
- Open and permanent communication among different levels of enterprises

Centralization of business' policies -in their formulation and implementation- and their hierarchical delimitation ensures the principle of administrative cohesion; it can make efforts to be more convergent. In this scenario, synergies that arise from cooperation mechanisms within organizations tend to give enterprises' perform, results with lower level of physical and economic effort. With implementation of hierarchical and centralized policies you can allow a high degree of internal efficiency, efficacy and timely results (Varela, 1991; Morgan, 1997)¹⁰.

This enforceability is aimed at achieving efficient results, use of efficiency -generating the results you wanted- and not at a least priority, a sense of opportunity in generating products. This hierarchical approach allows enforceability while inner working mechanisms can be secured in each one of the different levels of the organization (Gell-Mann, 1995).

Decentralization of operations and logistics are intended to prevent the formation of bottlenecks, or "operating knots" that can provide specific "functional power" to members of staff -forming "power pockets" or "firm power" to particular individuals- but usually interrupting the otherwise, fluent functions. This principle of decentralization potentiates greater or full for effective utilization of human resources efforts within conditions of organization or companies (Waldrop, 1992, Hansen, 1999).

The principle of openness of communication channels prevents the fact tha certain people can exercise power "on behalf of" bosses. This practice is increasing to the extent that executives can exhibit tight and a no-communicative behavior; just talking with a select group of collaborators. This kind of conduct can lead to form a "court´s people" system. That is to

10. According to George Odiorne, cited by Koontz & Wehrich (2012: 502) recommendations regarding the maximum effectiveness of human resources are: (i) establishing in a clear way, aims and objectives; (ii) articulated perspective and formulation of tasks and long term objectives, keeping up with motivation; (iii) constant learning processes; (iv) achieving better levels of company´s performance; (v) use of full capacities based on last generation technology; (vi) allow influences of positive feedback.

say, an scenario in which people can hold internal organizational power by virtue of being the only ones that have the possibility to access the members of senior corporate, or high level of management (Axelrod, 1997; Hurst, 1994, Wilson, 2003).

FINAL REFLECTIONS AND CONCLUSIONS

Concepts related to complexity theory provide means for enriching visions, integrative and dynamic studies of the different units of reference. From these perspectives one have elements that allow a view of trends which can be identified as set of factors, aspects of fundamental or conjectural causation.

Essential components of organizations are fundamentally related to the identification of objectives, definition of functions to achieve the objectives, organizational aspects and hierarchies within the internal sphere of enterprises. These components become more or less important based on the main types of mainstream culture. General cultural features, indented in this paper are those of the “culture of formal hall”, put emphasis on the hierarchy and organization. A culture based more “on workshop values” tends to emphasize objectives and functions in order to reach the first ones.

Issues operating in the context of concepts discussed in this paper determined that there are three measures that can enable management, to achieve more relevant and effective performance in terms of consistency of direction and flow of operations. These three principles or measures are: (i) the centralization of business policies into a hierarchical perspective, (ii) decentralization of operations, and (iii) the permanent opening of channels of communication and dialogue between different levels of the companies, avoiding the systems characterized by “court´s people” systema; i.e. those who can talk to the high level management have, because of this attribute, significant power.

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