

Impact of the Non-linear Dynamics in the SMEs

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Abstract: Currently, SMEs face the complexity of the business market, being these the most susceptible to failure caused by diverse socio-economic phenomena. Large corporations are the main rival of SMEs because when events that alter economic and social policies in a country or region occur, they have the strategic factors to challenge the chaos that arises, unlike the SMEs that don't have the resources, strategies and in many cases adequate knowledge to deal with market problems. But, which are the strategies that the large corporations apply to deal with chaos?

In recent years studies about the non-linear dynamics have been widely accepted in the business field, authors such as Lorenz, E. (1963); Nonaka, I. (1988); Koput, K. (1997); have concluded that organizations don't meet their projected prospects due to the application of a retrograde administration that many times have resulted in the cessation of them.

Keywords: Non-linear Dynamics, SMEs, Self-Organization, Chaos Theory, Complexity.

I. INTRODUCTION

The introduction of the paper should explain the nature of the problem, previous work, purpose, and the contribution of the paper. The contents of each section may be provided to understand easily about the paper. (10) The reason of the present investigation have as a priority the scientific research, and seeks to couple the factors of quantum physics in the business world having as a reference the SMEs; the non-linear dynamics gives another perspective to the administration, highlights the organization as a living being in which the cause and effect principle is excluded, and where in both external and internal variations, no matter if they are minimal, may affect the company's objectives in the short or long term.

The Renaissance, epoch that gave light to the scientific revolution, where figures like Copernicus, Bacon, Descartes, Galileo and Newton stood out in 16th and 17th centuries and originated a radical transformation in the history of knowledge, so decisive and important that it has been described as one of the most significant ruptures in the western civilization history.

The scientific revolution of the 17th century must be understood in reality as a part of the intellectual revolution that started in the renaissance and that formed the basis from which the new society is configured. With the emergence of the renaissance, the control and the authority of the church was weakened by establishing changes in the structure of the social blocks of power and generating a particularly fruitful political dynamic for cultural innovation.

The Newtonian physics to which the linear dynamics corresponds, led to a mechanical vision of reality, vision that would extend to other areas of knowledge.

Frederick Taylor and Henry Fayol, both considered as the greatest exponents of the scientific administration, followed the same scientific thinking established by Newton, who regarded the universe as a big machine.

Globalization has shown that the organizational structures aligned to the Taylor and Fayol principles are currently ineffective and inefficient for decision making, for detect new opportunities, for generate and implement effective strategies, for maintain a great organizational culture, etc.; which at the end brings a competitive disadvantage and economic instability. Currently, the environment and the scenarios of the traditional administration's paradigm are still valid in the SMEs, showing that the traditional methods used in business management fail to solve the actual needs of customers, employees, shareholders, suppliers, etc.

II. NON-LINEAR DYNAMICS IN THE ADMINISTRATION

In the second half of the 20th century emerges with impetus in numerous disciplines, independent of each other (biology, chemistry, physics or mathematics, among others), a new form of doing science, based on a

non-linear dynamics; represented principally by the theory of chaos and the science of complexity, which are characterized by the property of unpredictability, leading to a new way of doing science against the predictable character of linear dynamics.

In a recent review about the systemic thinking, Flood [1] identifies the theories of complexity as a deeper approach to systems theory or systemic thinking. The central axes that he profiles of the complexity sciences are the limits to predictability and how self-organized interactions at the local level can produce global and coherent patterns of behavior. This means that self-organized systems produce an emergent order that can't be known by the human mind. Seeing the theories of complexity as a closer approach to systemic thinking implies once more the delimitation of a system that only covers known local interactions, but that again relegates the new and the unknown to an external position to the system. The literature that postulates of theories of complexity has imported to the field of business management, have done it from the theory of chaos and the theory of complex adaptive systems. All of them model complex, turbulent systems and demonstrate the possibility of an order that emerges from disorder as a consequence of processes of spontaneous self-organization in the absence of any predesigned plan.

Chaos is usually defined as a condition or situation of great disorder and confusion. Scientifically, the world chaos is associated in the field of mathematical physics to aperiodic states, of unpredictable behavior that appear in some dynamic systems with extreme sensitivity to variation in initial conditions. In the past, scientists considered that a movement governed by a dynamic system was quite regular because its successive states were continuously generated from each other. At the end of 19th century, Henri Poincare [2] discovered that certain mechanical systems whose evolution was governed by non-linear equations became chaotic. This was considered a mere curiosity until the 70s with the discoveries of the meteorologist Edward Lorenz [3]. The theory of chaos at its origin is developed in the field of physics (fluid dynamics) and mathematics with the discovery of non-linear dynamic phenomena whose behavior seemed random, even when they were determined by precise laws; that is, non-linear dynamic systems that behave unpredictably and chaotically. However, the development of the theory has emerged after the 60s with the expansion of digital computers and their great computing power. Some of the characteristics that a chaotic system presents are: sensitive dependence of initial conditions: it means that a small disturbance or a small change in the conditions today generates a great effect in the future which makes them not very observable and difficult to predict (sometimes it is confused with a random behavior); it is the well-known butterfly effect. The strange attractor is very important because it makes chaos determinable in certain aspects, although it seems to be unpredictable. In mathematical terms, the attractor is the limit and represents the situation towards which the system tends; even though it is impossible to know the movement of the system in each moment.

To the extent that the scientific advance provides new theories in different fields of knowledge, researchers try to use new theories in other areas of knowledge; this is how the theories of complex systems and chaos that have their origin in physics have been applied to studies in areas such as psychology, anthropology, logistics, economics, etc.

Planning is one of the essential elements used by the administration in order to predict the situation of the organization in relation to its environment and its competitors, this planning that is relevant in the administrative process is established based on a linear analysis that doesn't include the diverse interactions that occur. Gallardo [4] states that: "The organization results from the location of the elements in a hierarchical order and with cause-effect relationships between them". A system is a set of elements interacting with each other with a purpose; this implies that the component parts exert an influence on the other elements inevitably impacting them. A system is then more than the simple sum of its components; the above generates two effects: on the one hand, the interaction of the parties will generate new properties in the system, different from those of their components, a situation that is called emergent properties and, on the other hand, the components inhibit or reduce their own characteristics.

The traditional approach of the administration puts its emphasis on control, order and predictable events; within this approach, non-controllable events, disorder, uncertainty and chaos, have been considered adverse to the notion of organization, therefore they must be eliminated from the company. Faced with this approach, authors such as Nonaka [5] affirm that chaos and disorder are properties intrinsic to the organization and that the disturbances suffered by organizations, to which managers' struggle, are really opportunities for creation. That means, an organization managed in a chaotic way will be in a state of constant evolution, will welcome the instability and will create the crisis as a way to transcend its limits (Mintzberg, Ahlstrand, & Lampel, 1998). Contrary to the order, control and forecasting approach, chaos theory suggests that events are unpredictable, that irregularities are a fundamental property of organizations, where small disturbances can have large effects (sensitive dependence in initial conditions) and where the degree of disorder is high. Therefore, managers can't be based on systems, rules and procedures, but must be prepared to adapt to the new

continuously and catch opportunities everywhere. Mintzberg, Ahlstrand, & Lampel [6] suggests that some of the lessons left by chaos theory for strategic management are: (1) long-term planning is difficult, as a result of dependence sensitive to initial conditions, (2) firms do not reach a stable equilibrium (3) a drastic change may occur unexpectedly, due to the entry of something new into the environment, (4) short-term forecasts and pattern predictions can be made due to the degree of the existing order within the chaos and (5) guidelines are needed to face complexity and uncertainty. For Singh and Singh [7], chaos theory would explain a flexible organizational culture in the face of growth and change, rather than an organizational culture opposed to change to maintain the status quo. Therefore, the culture of an organization must focus on the search for new ideas and on adapting to the elements of change. This new culture would serve to protect the survival of the organization under the changes that the unpredictable future of the business holds. The authors affirm that chaos theory also explains the abandonment of stability and control, by innovation; a prolonged equilibrium would be a precursor to the disaster; however, the advances that cause an innovation would close the link between stability and complexity. It would also ensure the strengthening of the organization by continuous flows that keep it active and alert. The self-organization of an institution can be seen as a process of dissolving the existing order to create a new one Nonaka [5] argues that self-organization is essentially the creation of information and, from this perspective, the process is carried out through chaos and fluctuation. In addition, fluctuation enters into cooperation with the organization to resolve its discrepancies and form a new order; thus, the information created and accumulated in that process is transformed into knowledge. Essentially, the self-organization strategy of an institution resides in the ability to handle the dissolution and continuous creation of order.

For Koput [8] the theory suggests that it is possible that stable processes may be able to generate and select new innovative ideas; in the natural growth cycle, the organization needs to alternate between moments of development (creation and expansion) and moments of control (consolidation); in addition, they must mix the use of these values (control and development) in each situation to reach an acceptable level of social and economic results [9]. There is an order within the disorder, a meaning within the change and a purpose in the complexity of the change. Chaos provides the dynamics of change and facilitates the understanding and control of its complex processes. Although there may be random processes and completely unpredictable complex changes beyond our control, control of chaos is within our control [7].

III. NON-LINEAR DYNAMICS AND SMES

At the end of the 20th century, industries entered an era of change, and new variables that directly affect the organization and therefore the administration emerged. The acceleration of change, globalization, the increase of competitiveness, the new information and communication technologies gave access to a new economic and social order.

In the 21st century, technological changes, ambitious competitors, fractured markets, omnipotent clients, seditious shareholders and increasingly demanding consumers are testing the theories of the paradigm of traditional administration that can't meet the current demands of the society; it has generated a chaotic scenario, in which on the one hand, cost are reduced and production is accelerated but, on the other hand, it raises the risk and uncertainty of which SMEs have figured as constant victims [10].

Nowadays, SMEs challenged by large organizations are in a state of risk, the continuous decline in their productivity and profitability because of the steady decline in their operating income and which have resulted in shortages of liquidity and solvency have caused SMEs enter a chaotic state from which they have not been able to disassociate themselves.

Ignorance of the nature of markets, the difficulties in anticipating problems and the slow reaction to search for solutions, as well as the scarce use of opportunities, have been recurring features of the chaos that SMEs experience. This, beside the current trends, make it necessary to adopt a new way of producing, the use of new work tools, the creation of new organizational structures, as well as the development of new work and business behaviors [11].

Large corporations generally seek to maintain an order by successively applying corrective measures that allow them to continue with their operations; this is because the personnel that make up the system have the human capacity to choose and determine, in part, the future of the system. This internal and external correction directive is called self-organization. A non-linear system is capable of organizing itself indefinitely, provided that its members have the capacity to make it serve to the organization of which they are part; how it can be appreciate, non-linear systems are important for organizations when they try to stay alive in an ever-changing and sometimes hostile environment.

It can be said then that a system, as an individual company, is also part of a larger system which, in turn, is part of an even larger one, and so on, until all the interrelated parts have been integrated according to the largest system that is known.

It must be taken into consideration that nowadays society creates complicated problems in the market that it didn't have to face before. In those days commercial and social relations were simpler than now, and even the few complexities that did exist were generally overlooked. The decisions were clear, well defined. Therefore, almost all the intricate problems of current civilization seem to derive from the rapid change that alters the delicate balance of a complex social system. Non-linear dynamics clearly deals with a relation of systems, in which social, educational, technological and other types of changes are closely related to each other. The change increases the imbalance between social institutions and therefore increases the frictions between them. This in turn requires greater efforts, resources and knowledge to recover some kind of possible balance. However, our modern civilization, according to Peter Ducker [12], is experiencing something more than a time of change.

IV. CONCLUSION

Currently, the studies aligned to the Taylor and Fayol theories can't give total solution to the chaos in which SMEs live; from the 20th century with scientific discoveries in quantum physics and then the revolution of information and communication to reach what is now the digital economy; it has changed the perspective of the world and therefore of the market, transforming it into a chaotic and complex market in which the linear or mechanistic systems no longer give total effectiveness; so that organizations enter a state of emergency and uncertainty so they need to self-organize.

Unlike large organizations, SMEs have been the most affected, since most of them have not been incorporated into globalization and therefore have not self-organized. In this process of self-organization, the Newtonian thought that considered the world as a mechanical system that can be described as the sum of the parts that make up the system and that doesn't take into account the human observer is changed, to these thoughts were linked Theories of Taylor and Fayol. The theory of Chaos and the Science of complexity designate the company as a living being in which its members possess different skills and abilities that by interacting and working in groups can effectively find order within the disorder and achieve a common goal, improving the company's results in a constant way.

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