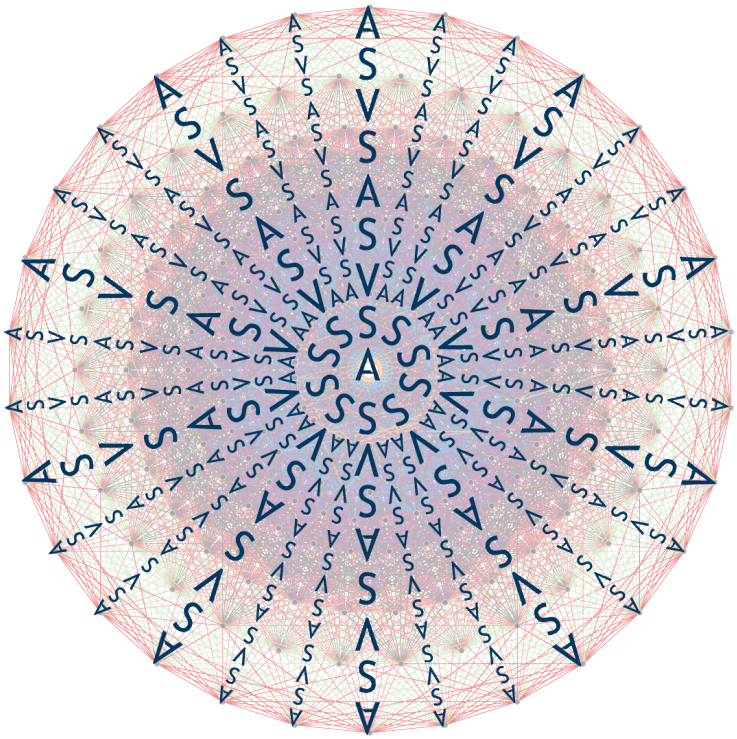

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CHAPTER II

QUALIFYING THE CONCEPT OF SYSTEMS COMPLEXITY

Sergio Barile and Marialuisa Saviano

1. INTRODUCTION

The theme of complexity is of great interest to many researchers in both scientific and humanistic disciplines. However, the concept, examined quite considerably and at times, quite superficially, risks ambiguous uncertainty in terms of comprehension and acknowledged meaning (Barile, 2009b).

Although the *common* use of the term implies issues that are almost impossible to resolve, the technical meaning, from researchers in diverse disciplines, has taken a step forward in terms of extended meaning. This however, poses the problem of finding a common denominator and acknowledging a basic accepted use.

The diverse paradigms developed within the realm of literature on complexity – from *complex adaptive systems,* to *the algorithm theory on complexity,* to the *epistemology of complexity,* or even the *computational theory on complexity* – define research limits and studies that intersect, contradict, find the same agreement, but which, being based on actual knowledge, do not seem connected to a single scientific corpus that is cohesive and well defined (Simone and Faggioni, 2009).

Accordingly, in order to make a useful contribution, to the debate on *systemic complexity*, a few explicit premises are needed.

In a cultural context of particular themes not underpinned by founding principles or based on well defined conditions or interpretative schemes, a more simple path might be to contribute to constructing the conceptual framework so as to clarify the research perspective. This is an essential process for identifying the direction of debate.

In specific cases albeit not desiring to trace the genesis and evolution of different paradigms that summarily make up the *"complexity theory"* (Bateson, 1979; Delattre,1984; Dupuy, 1988; Pilati, 1990; Morin, 1993; Alferi and Tommasi,1993; De Angelis, 1996; Cammarata, 1999; Cini, 2001; Taylor, 2005; Bocchi and Ceruti, 2007), it is imperative to define the perspective and clarify the dimensions which limit the area of analysis (Barile, 2000). Furthermore, "*margins*" in which to appraise and interpret results should also be defined.

2. PERSPECTIVE ELEMENTS FOR THE RESEARCH PROCESS

Exploring existing conditions and, where possible, the measuring of the level of *complexity* in typical business economics scenarios, assumes that from the beginning in the interpretation of reality we identify, and share *elements* on which to base observations and further reflections. In business economics literature omitting the indication of such elements can generate results which are often not comparable and, sometimes, quite contradictory (Barile, 2009b).

The approach used in this paper is justified in our view, to substantiate the expressive characteristics of manifest complexity. In this respect:

I – Different observers (*do*)

Different observers perceive a different level of complexity

If we consider the cognitive action inducing "*perception*" something that is more or less *complex*, it can be implied that:

a. *an "object" exists, i.e. a phenomenon or a process, can be observed;*
b. *an "observer" exists, i.e. a "viable system" that perceiving*

the above "object" proceeds to express considerations concerning the same.

It should be noted that the assertion a. implicitly postulates a specific element: a phenomenon, a process or a material object being observed. that the attribute *"complex"* besides being intentionally underlined also qualifies not only the case or the object in itself, but also the *context* in which it is perceived.

This consideration leads us to believe that perceived complexity also be attributed to a material object, for example a "Rubik cube" (see Fig. 1), is quite "naïve". It is not the Rubik cube in itself which is complex; rather it is the process of solving the enigma of the Rubik cube that can be defined complex, i.e. the need to juggle with every tassel so that each side is lined up in the same colour (Fig.1 b). It is evident on the other hand, that anyone merely wishing to play with the cube and not to uniform the colours on each side and simply rotating the pieces of the cube in a random fashion (Fig. 1 a) obviously, the activity appears far from complex.

Figure 1 – The 3x3 Rubik cube

Source: personal elaboration.

Therefore, we can safely say that only an individual's intentions, the perspective with which he views reality, the objectives that he sets himself, are the elements which allow complexity to emerge. The interdisciplinary debate on complexity, initially developed in the realm of physical sciences with studies concerning irreversible thermodynamic phenomena has implicitly led most researchers to maintain that complexity is a phenomenon that is such, always and everywhere, independent of the observer, from the time and place of observation (Kauffman, 2001:33).

In the reality of social phenomena including related problems within business organizations, the hypothesis is not easily accepted.

The consequences of the view that rejects the attribution of an

objective character to complexity, are significant in the area of business disciplines and elsewhere.

As a consequence, the findings of most studies, and therefore the validity of models and theories which are consolidated, take on a completely different perspective in the light of the presumed objectivity or subjectivity of perceptions and the absolute or relative character of conclusions.

Considerations which are deemed apodictic such as: *the old paradigm tends to rebuild stability, predictability and low risks ("failsafe world"), whilst the new paradigm bases itself on the assumption that the future is unpredictable and turbulent and it is therefore important to govern instability in order to keep all options open ("safe to fail world)*, in virtue of what exposed, seem to be very questionable (Pascale, 1992:388). On what has been introduced, a paradigm that can define itself objectively old and obvious and, against, a paradigm that must necessarily be considered new and complex, do not exist.

There is no doubt, for example, that the *Fordist model of production* the structure and processes of which are not complex nowadays even for the most poorly educated or small businessman in the western economics scenario, would be considered complex, if not completely incomprehensible (therefore *chaotic*), for a new businessman in a tribal society still based on bartering.

Substantially the contrast between what is defined as a *"classic paradigm"*, simple and evident, and what is intended as an *"innovative paradigm"*, emergent and complex, lies in the implicit premise concerning the relationship of *"novelty"* that exists between the stakeholders involved (the community of reference intended as the *context*) and the measure of eventual *complexity* that is attributed to a specific situation. However, what is relevant, is the set of real and consistent characteristics of novelty that materialize in a specific situation and which individuals on the basis of their *interpretation schemes* are trying to understand in a precise moment of time or rather, their capacity to associate and align new situations to those already experienced and resolved in the past (Barile, 2009; De Toni and Comello, 2005:145).

Therefore nothing can be defined as objectively complex and absolute. The attribute "complex" can only refer to the incapacity of observers to subject their perceptive interpretative models to the phenomenon or objective event under observation.

A new situation which is incomprehensible to an individual by virtue of lack of or little background knowledge on the subject will obviously be considered more or less *complex* . In other words:

II – different moments (*dm*)

The "same" observer, at different moments, perceives different levels of complexity

Usually we contrast what is *simple* to what is *complex,* in the belief that the dichotomy can exhaust all casuistry of phenomena and possible events, and that the definition of *simple*, enables by exclusion, to establish what is *complex.*

In order to identify the characterizing elements of systemic complexity within organizations, the distinction between simple and complex has very little effectiveness. Above all in reference to business dynamics, although processes of governance or those of management can clearly be defined as *not simple,* in many cases, they certainly cannot be considered *complex.*

Invoking *complexity* as a 'determinant' of inefficiency as reported in numerous *case histories* of failing businesses, renders excessively trivial both the decisional and operative dynamics that characterize the path to survival of many companies. At the same time, this viewpoint drastically simplifies the casuistry and renders vain years of studies of theory and practice on which management theories were based and developed. On the other hand, the commitment on the part of researchers, consultants, businessmen and managers in disseminating theoretical knowledge, as well as problem solving techniques has contributed to the devising of methods that were appropriate for resolving complex business issues. The long path to the transaction costs theory (Coase, 1937), through the recognition of the role of organization (Williamson, 1996), affirming the fundamental importance of capacity linked to components (Chandler, 1962) and formal relations (contracts) that are established (Jensen and Meckling, 1976), are cases in point, defining the main structure for interpretative schemes (i.e. the "fundamentals") for company management.

Further studies in relation to intangible resources (Penrose, 1973), which combined lead to competencies, and the concept of routine (Nelson, and Winter, 1982), paving the way for the relationship between processes and performance (Wernerfelt, 1984). The development of broader theories, capable of ensuring and justifying

interaction between fundamental resources, knowledge and development of competencies (Teece, Pisano, and Shuen, 1997), marks the advent of the systems conception of business and endows a conceptual perspective to the discipline of business management. The contribution of *resources, capacities, competencies* and therefore, the appropriate use of *methods, techniques,* and *instruments* guarantees the pursuit of paths that are efficient and effective for the attaining of company objectives. By reducing to categories such as on the one hand, "simple", certain, obvious, and therefore obtainable by any operator, regardless of his professionalism and knowledge, and on the other, categories such as "complex", emergent, outweighed, in other words, considered as something that is not easily dealt with by using classic methods and therefore, effectively the real dynamics of an organization.

A more suitable classification would consist in a taxonomy that includes in the description of phenomena and events, the categories of *chaotic* and *complicated.* Only then would it be possible to detect and justify circumstances and situations that are generically definable as *complex* but that in substance can be considered at most governable (with commitment) and defined *complicated* and in other cases, as ungovernable, impossible to frame within any type of interpretation scheme and therefore, *chaotic.*

Returning to the example of the Rubik cube, it would be plausible to affirm that for some people the mechanism of the puzzle is an enigma; in the *chaotic* category as they are incapable of imagining how to proceed, for others *complex* (they imagine it can be solved but they do not know how to proceed), for others yet again just *complicated* (they have an idea of the algorithms and keep trying to find the solution) while for a minority the solution is really quite *simple* (requiring, despite appearances, only a few minutes).

Similarly, by indicating the diagram in Fig. 2 to students of an Economics Faculty in any University and asking them to explain the graph and the numbers and tags inside the squares, the outcome will result in their considering the exercise *complex.* Clearly, for any student the exercise is merely *complicated* as opposed to *complex after* they have listened to a lecture illustrating the figure represented in the PERT diagram, indicating that:

- each graph of this type begins with a point where the specific process starts;
- each activity is indicated by name, indication of assigned

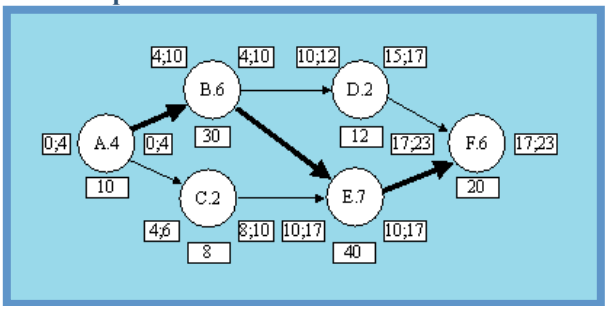
resources, minimum (sometimes average) and maximum, timescale and the result linked to other activities;

– each activity is indicated by name, assigned resources, minimum, (sometimes average) and maximum timescale, and results as being connected to other activities;

– the process is completed when all the related activities in the graph converge at the point of completion.

It is also reasonable to suppose that in the event a student using the PERT technique, becomes familiar with the tool, the explanation of the diagram in Fig. 2 finishes, before or after, to be qualified as a simple task to execute, of which there is a definite resolution.

Figure 2 – An example of PERT chart



Source: personal elaboration

It follows consequently, that prior knowledge and therefore the *interpretative schemes* held by an individual, significantly influence how the path that by modifying the level of complexity perceived, is traced relative to a specific environment.

The schemes are similar to coloured lens which when worn, transform the environment. If wearing sunglasses that obscure vision makes it impossible to see objects that are dark in colour on the contrary, they sharpen the focus on objects which are light in colour. Due to the effect of interpretation schemes, therefore, the capacity of viable systems to give significance to the environment can vary enormously, determining the emerging of different contexts. In this perspective, one of the founding concepts underpinning marketing theory, that companies pass from a product-oriented to a market-oriented approach, is none other than the principle described above: we cannot possibly define the correct marketing strategy if we do not understand the effective needs of the market; which can be achieved

only by wearing "the glasses" of the consumer.

In conclusion, we can assert that the potential level of "comprehension" individuals attribute to a specific situation depends on the knowledge they possess when they interact with that situation at a given place and moment in time, (Golinelli, 2008:5).

Evidently, with the evolving of an individual's knowledge patrimony, the level of comprehension they attribute to what is observed, can vary.

III – Different system (ds)

It is different perceiving an event from inside the system that has generated it, as opposed to observing the event from outside the system itself.

A further aspect which needs to be considered concerns the definition of the perceiving individual. Above all when referring to the constituent characteristics of systems complexity, it is fundamental to specify whether the perception of the system and its dynamics is on the part of an external or internal observer of the system under observation.

The space-time perspective taken by the observer, based on his being or not the main actor in the system process, becomes a discriminating element with respect to the real possibility of recuperating useful elements for the reduction of complexity.

In essence, belonging to different systems, albeit present in the same environment, allows for the identifying of different contexts and, as a result, of different stakeholders (supra-systems). Co-existing in a viable system means, therefore, being subject to the strong influence of such supra-systems and therefore, being conditioned in the perception of complexity by their capacity to influence the systems process (Gatti, 2008:55). The path to survival identified by the governing body of a system cannot but take into consideration all the conditions, constraints, rules and expectations imposed by the supra-systems to which they attribute relevance. This means that a specific scenario is designed wherein some features acquire prominence at the expense of others. Clearly, the difference is evident in the scenario defined from the point of view of a businessman who at a given moment, conceptualizes himself as a relevant component of the company, involved in the realization of strategies aimed at guaranteeing compatibility as opposed to that of when the focus is on

himself or his family and the company seen only as a tool to achieve his ends. It is this change in perspective that clarifies apparently irrational entrepreneurial decision making. In many well established companies "cracks" as well as improbable adventures in the sports world, soccer in particular, entrepreneurial behaviour finds justification in ambitions deriving from changes in perspective and definitions and, therefore, from belonging to different decision making systems.

IV – Different representation (dr)

Structure representation, rather than system representation, induces perception of different levels of complexity

As noted in the *Viable Systems Approach (**VSA**),* the concept of viable system assumes that the *structure* in its essential meaning, must be divided by physical boundaries, to distinguish the internal from the external context, whilst the *system* must be considered as absorbing the totality of what is perceived (Golinelli, 2000, 2002, 2005, 2008, 2010, 2011; Barile, 2000, 2006, 2008, 2009). In fact when the components included in the system interact (even on an abstract level) with a new component, it is included in the system and becomes part of the same.

Consequently, for instance, when the administrative staff of a company creates a relationship with a bank, the institute becomes inserted in the extended structure of the company in question, and from that moment on any activity that derives from relations with the bank affects the company system which is extended indefinitely to include all the components of the bank participating in the process itself.

Hence, in defining a potential measure of systems complexity it is essential to distinguish between:

a. complexity measured by virtue of the articulation of the *structure*;

b. complexity evaluated by virtue of the comprehensiveness of *system* processes.

The distinction, not new in business management, albeit not always explained, constitutes a relevant factor underpinning complexity, in suggesting measurement systems, rather than representing potential dynamics.

In this respect, Dioguardi argues that *it is important to underline*

how useful it is to preliminarily define knowledge of a structure by means of reductionist approaches, whilst the momentum it determines, the strategies enacted, need to be the object of a synthetic systems study characterizing the approach to complex systems. In the typical world of business organizations, where life is lived between structure and strategy, predictions on the future and related planning and processes are of fundamental importance (Dioguardi, 2000:67-68).

On the contrary, in the scientific realm of epistemology, Dennet indicates the possibility that the measure of complexity in a system could depend on perceptive attitudes. He distinguishes between three potential attitude types: *mechanistic, functional and intentional.* A *mechanistic* attitude involves considering the system as a machine, a set of components that work together. Clear vision linked to a physical structure, in which analysis reducing further such elements, becomes the essential diagnostic tool; the car is visualized from its component parts: engine, body parts, tyres, etc. On the other hand, the *functional* attitude considers the system in instrumental terms, something that is useful for a purpose. A car is considered in terms of a useful system of movement from and to different places, even in bad weather conditions, offering significant security margins, etc. Finally, the *intentional* attitude, is tied to a specific perspective of action: a car as a means to seeing a particular film, projected at cinema "X", in a particular street.

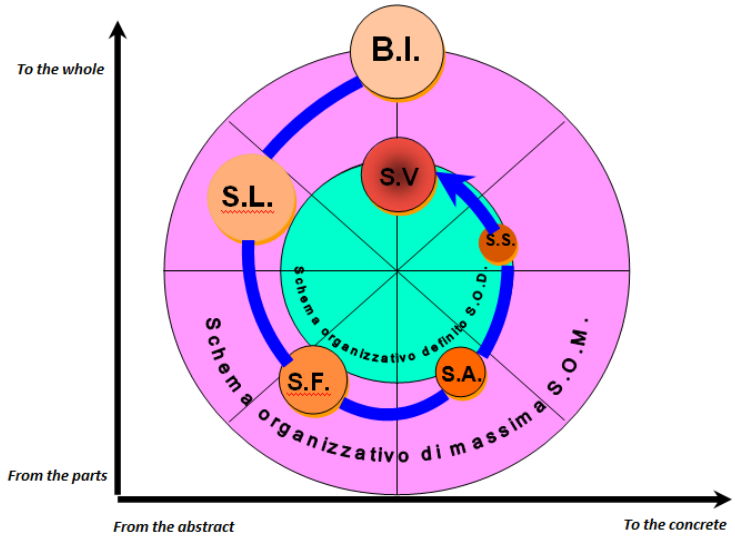
It is easy to see that the need to attribute a measure to complexity, by virtue of the different attitude used, leads to contexts which are not measurable, and therefore, the levels of complexity are certainly diverse (Dennett, 1987:27-66).

The *Viable Systems Approach* (***VSA),*** by means of its conceptual framework approach, highlights the different perspectives, used implicitly and explicitly by an individual when observing company organization (Fig. 3) (Golinelli *et al*., 2002).

The conceptual framework scheme clearly distinguishes between *structure* and *process and* includes explicit elements from strategic, organizational and decisional phases. Ample literature inherent to the conception of closed and open systems, of mechanical and organic models, of static and dynamic environments substantiate and confirm the VSA approach (Cafferata,1995, 2009). Researchers have identified and defined many issues linked to company policy, that have distinct

elements in common with regard to the problems a company has to deal with.

Figure 3 – The (*VSA*) conceptual framework



Source: Adapted from GOLINELLI, 2000, www.asvsa.com.

3. QUALIFYING COMPLEXITY IN SOCIAL DISCIPLINES AND BUSINESS MANAGEMENT

A study of the literature concerning complexity in business management evidences the articulated nature of the concept which is also conditioned by multidisciplinary influences as well as by each author's specific paradigm of reference. Certainly, the unresolved issue of definition remains. In other words, whether the business organizations and the contexts in which they operate are complex or rather, the models and theories adopted to represent them.

Le Moigne (amongst others) argues that *no complex (complicated) phenomena exist as such but rather, complex constructive models of "observed" phenomena that are "dans notre tête"* (Le Moigne, 2002:27-28).

Furthermore, as mentioned previously, qualitative differences between the complexity of *physical* systems and that of *social* systems are also relevant as well as the issues relating to measuring complexity levels.

From an appraisal of the main indications formulated by researchers that have addressed the issue of complexity in business systems, we attempt to identify relevant similarities and differences in order to devise a common framework which albeit a new approach, takes into account the varying positions expressed.

A preliminary factor in any definition of complexity has to consider the traditional distinction between *quantitative* and *qualitative* analysis. As is well-known, quantitative methods allow for the transposition in real time of useful dimensions/data to obtain measurement criteria, while in the case of qualitative considerations, this is often, not feasible.

In this respect, however, Gell Mann sums up the concept quite well: *probably not a single concept on complexity can grasp in an adequate manner our intuitive notions of what the word might mean. We would therefore, need to define various types of complexity. Some of which have not yet been conceived* (Greco, 1999:96-97).

Thus we are exempted from having to justify our incapacity for devising a comprehensive synthesis of definition.

In the range of quantitative representations of complexity in social environments, many different authors have contributed more or less significantly to its definition, Tainter for instance, has identified the following guidelines (Tainter, 1988):

- size of the company;
- number and characteristics of components;
- variety of social roles and personalities;
- variety of social mechanisms for assembling the parts and roles into an integrated and efficient whole.

From a European perspective, in Italy, Ardigò for instance, albeit in different terms, gives a definition which is substantially similar to the previous one (Ardigò and Mazzoli, 1990:44):

- elevated number of elements in a social organization;
- intertwining of elements within the social organization;
- growing asymmetry between institutions and partial social systems;
- abstraction and reflexivity in a social context.

Even for Simon, complexity is *a system composed of a large number of parts that interact in a not so simple manner* (Simon, 1969:86).

Thus far we are dealing essentially with quantitative representations in which what seems relevant is the structural view of the system analyzed, along with the environment in which it interacts. It is evident that such a perspective doesn't exhaust the choice of useful dimensions for the study of complexity in organizations.

Atlan best describes the quantitative dimension, proposing three representative characteristics of emergent complexity: *complexity is characterized by a large number of parts that are linked in various ways*; *complexity is an emerging phenomenon whose exact form cannot be predicted*; *the neg-entropic processes that operate in live organisms produce an evolution that seems oriented towards a greater complexity* (Atlan, 1972:230).

Atlan's considerations imply that a sole perspective of numeric growth of the various factors cannot include all the signals that normally preclude the emergence of complexity. For many researchers, it seems clear that not only the components at play are important, but also the (changing) *rules* of the game are just as important.

As concerns business economics research, the previously mentioned positions are directed to specific factors on business decision making.

An analysis perspective based on an essentially structural conception of complexity seems to resist and decline both as concerns the internal and external mechanisms in an organization. However, in many studies it seems evident that the attention is being shifted to aspects and factors that do not lend themselves well to being the object of scale or measure.

Vicari has summarized the elements on which the growth of complexity in business organizations seems to depend (Vicari, 1998:20):

- from the factors that management has to consider, the quantity of data that has to be used, the number of elements that are included in the problem that needs to be resolved;
- the variety of the data itself, diverse problems, the number of variables with which the problem presents itself;
- the variety of facts that a manager has to take into

consideration, the level of non stability of the problems, their inconsistency over time;

- the variables which can influence the problem and that are not known by the decision maker.

The Author, despite having no predisposed formal criteria for the measurement of complexity, suggests two different approaches to its governance: the first to stem it, the second to coexist with it.

Rullani, in making a distinction between simple and complex, adds a strictly structural view to the systems perspective, arguing thus: *we can say that a problem, a solution, a context (in which the problem is to be found), a point of view (with which it is observed) is complex if we acknowledge high variety, variability and indeterminacy for potential situations and events* (Rullani, 2008:78).

Even more explicitly Cafferata maintains that complex systems can be analyzed under quantitative and qualitative aspects, evidencing that *firstly, complexity is inherent to a number of variables at play in the social system and within each organization; secondly, complexity refers to the fact that individuals and organizations are continually interacting and open to unpredictable outcomes, with qualities that are not verifiable* (Cafferata, 2009:181-182).

Less direct and more allusive are Tagliagambe and Usai who affirm that *complexity is the excess of possibility of experience and action in any type of context, that can be, internally to the same, due to intrinsic limitations of the capacity for connection between elements, resulting impossible to connect each element in any instant to any one of the others. .Complex is therefore each unpredictable environment with respect to a sole reaction that can guarantee survival, is to maintain a high level of exploration and to be able to develop temporary structures that are adequate to evaluate any favorable occasion that can be established* (Tagliagambe and Usai, 1994:61).

Most of the stances adopted by researchers, in their perspective on business economics and complexity, are based on such positions. In short, we can say that (Fig. 4):

- *a perspective exists that distinguishes between business complexity (internal), and complexity which is found in the environment in which it operates (external);*
- *another perspective concerns the possible distinctions*

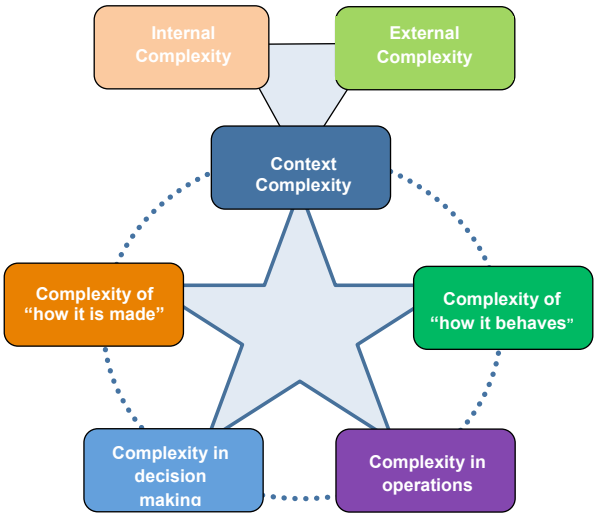
between complexity defined as "organizational", and complexity that is qualified as "decisional";

- finally, a distinction is made between complexity that is obtained by the company's way of being (quantitative structural perspective) and that which is obtained by the way it operates (qualitative systems perspective).

By virtue of implicit reference to a quantitative evaluation rather than qualitative, after analyzing the diverse areas, it is possible, for each one of them to justify the validity of many different semantic meanings with which we can define complexity in business management.

We must mention that not all the perspectives of analysis described in Fig. 4 were developed in literature with an equal depth and richness of results. As well it is opportune to highlight that certain perspectives of study, even if considered interesting by virtue of the possible developmental outcomes for knowledge, do not appear useful in any way to intervene neither in terms of representation of complexity, nor in terms of potential intervention to limit or reduce it.

Figure 4 – Perspectives of analysis of complexity



Source: personal elaboration, www.asvsa.com.

Furthermore, it should also be added that each of the areas in Fig.

4 can, in reason of methodology of approach used, or to be more precise, in reason of knowledge endowment of the subject's experience, emphasize operative methods which are completely different.

That is, for example, the area defined *complexity in decision making*, if referred to the classic decision making theory, as non psychological, can be attributable to certain postulates or axioms for rational behaviour, from which we can derive a function of real values, specific to the decision maker subject, based on the context in which he operates, on value or usefulness, on the basis of establishing that a specific choice is preferable to others if and only for the utility expected from this option results in being superior to the expected utility from alternatives. In the same way we fall into a type of instrumentation of calculations that will determine the quantity of components needed beyond which there is a loss of control, the number of relations that generate conditions of instability, as well as a limit on the proxy of activities to a sub-system beyond which there is a decline in reliability, in the perspective defined *complexity of "how it is done"*.

Instead, it is something different to try to decide with certainty when finding oneself in front of emerging situations, never before tested and difficult to confront with usual tools and techniques. Usually, every time we proceed to enumerate as well as count the constituent elements, and therefore "reduce" the reality in elements which are more simple, searching to obtain some kind of qualification, measure, of complexity, we are forced to operate under a *structure* perspective rather than a *system* one.

Even from a practical point of view, it seems undeniable that the so called structural approach and therefore orientation to quantify factors, relations, components, variables or other, is to be considered a privileged method of approach to evaluate the emergence of complexity, leaving a significant operative difficulty in the application of this type of perspective. It derives from the observation that, in a not so evident manner, the necessity for proceeding to the quantification determines that we pass inadvertently from *complexity* to *complication*.

In fact, if the line between complicated and complex is established by the numerical growth of one or more factors and not by other aspects, we end up falling into a classical dilemma: when do "few factors" become "many" and "many" become "a lot"?

In substance, if N equals for example the quantity of relations that render a case complicated, can we affirm that by adding one further relation to that case it becomes complex? That is, if N relations correspond to the extreme superior of that which is defined in "few" relations, is it reasonable to think that N+1 relations, therefore only one extra, will imply passing from "many" relations to calling the case complex?

It is reasonable to consider that the answer is no! Even N+1 relations have to be considered as "few".

Therefore the debate can be reiterated by first adding a relation to N+1, then another to N+2, and so on. Substantially it doesn't seem possible to establish when a relation is added and whether it will produce complexity.

We can conclude that unless the growth in the number of relations alters the capacity to "comprehend" the behavioural dynamics of the system then we will not assist in the emerging of complexity.

If this premise is accepted, an immediate consequence derives that in some way revolutionizes the paradigm of complexity in businesses:

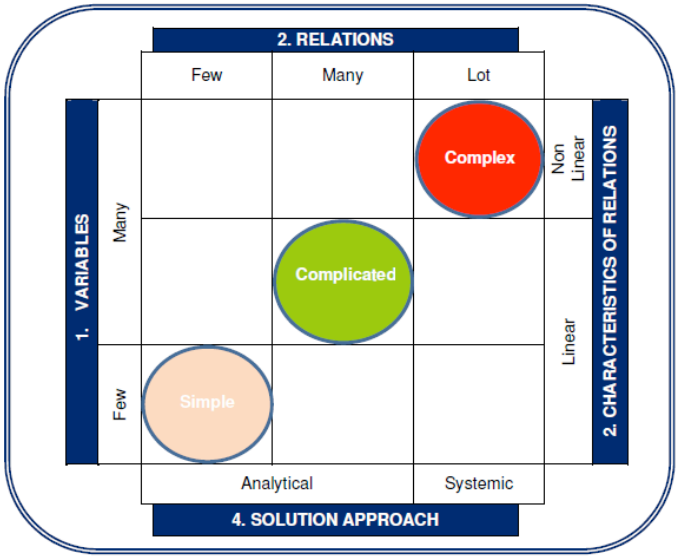
Complexity within the realm of social sciences, and therefore in business organizations, intervenes when it is forced to abandon the structural perspective and needs to evaluate "objects", both tangible or intangible, not enumerable on the basis of calculation criteria that is known, characterized by relational boundaries that become indistinct, in reference to relationships which change in time and space, and marked by discontinuous and emergent behaviour.

In essence, when the interaction that emerges from any type of relation that is activated in a specific process no longer responds to notable criteria, to behavioural regulations which are known and shared, or in short to a finalized organizational design.

The taxonomy of problematic areas listed in Fig. 5 can help to clarify the concept.

Once established that the quantitative growth of many variables as relations gives very little clarification with respect to the emergence of complexity, and having accepted that the analytic shift to the systemic is physiological, it becomes evident that the significant aspect can be none other than a characteristic of the relation, the fact that this becomes *non linear*, where linearity is intended as adherence to a potentially shared rational scheme.

Figure 3 – The dimensions of complexity



Source: Our adaptation from De Toni and Comello, 2005, p. 16.

If the founding element on which this reflection is based consists in what is intended for non linear character relations, it may be useful to proceed by summing up what has been discussed so far:

- the directives considered useful for the identification of adequate criteria of governance of complexity is due to a *system* and not a *structure* perspective;
- complexity manifests itself as the incapacity to orient and act using criteria and rules that were previously deemed useful; consequently, the indications to bring about change in lieu of recovery of stability cannot be directly and immediately "inferred" from past methods;
- the premises of the systems perspective condition to a great extent, the determination of constraints to apply to each potential contribution in defining a complexity paradigm in business organizations;
- as opposed to what occurs in physical systems where links amongst the parties are guaranteed by natural forces (laws of nature), for the most part known and not changing through time, the cohesion between components in social systems and therefore in companies, is founded essentially on relations with a limited duration, temporary

rules based on relevant relationships in continuous evolution;

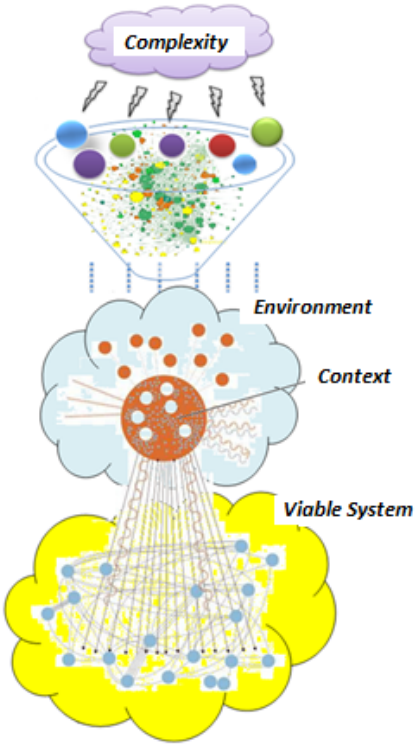
- at times the relations by virtue of the variability of relevant relationships in context, have generated interactions that end up being incomprehensible for the most part to the various interacting agents in the system.

It is precisely the concept of interaction which with its *functional* and *intentional* aspects, clarifies comprehension of the significance of "non linearity". It is evident that where the decision maker is not capable of understanding the context, the result is disorientation and loss of motivation (with respect to original intentions) self doubt (functionality) and intolerance in retrospect of consolidated relationships (non linear relations).

The relationship between a firm and its environment, with the consequent definition of the context, becomes interpretable first of all by virtue of the interaction of its components, both internally and externally. Once interaction has been activated it can produce the following multiple effects.

1. *Exceeding structural limits*: the system which emerges from the context has no boundaries (Fig. 6), and therefore the discussion on whether complexity is a prerogative internally or externally to the system loses significance. To affirm that the system emerges from a structure, surpasses the physical boundaries and extends itself in an indefinite manner, can generate certain interpretative distortions. It becomes difficult, for example, to reconcile this affirmation with what has been declared in the previous point (see point I - *do*). how is it possible to maintain that complexity has to be intended as distinct by virtue of the system from which it is perceived (see point III - *ds*), and at the same time maintain that when a system emerges from the structure it surpasses physical boundaries, extending itself and absorbing everything? If an emerging system expands itself completely, what happens to the other systems? Are they are all merged together? The apparent complexity of such a hypothesis is overcome if we reflect on the founding premise of viable systems. A viable system exists within the expression of perceptive activity carried out by a specific individual "observer". In cases where it has not been specified differently, considerations are linked to a privileged observer: the governing body. When an individual focuses attention on a system, all its surrounding reality is observed together with all the components of the system and relational endowment.

Figure 6 – From complexity to the emerging of viable system

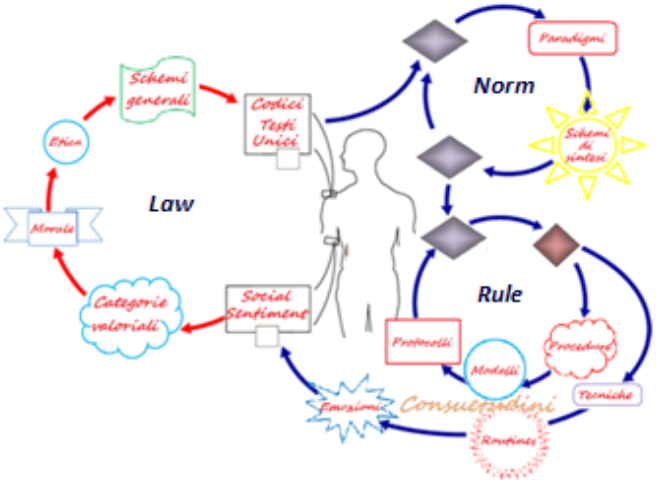


Source: personal elaboration, www.asvsa.com.

2. *Inter-system stability conditions are guaranteed by a relationship level based on consolidated procedures* (routines). At this level, relations, intended as the "norm" in terms of a well defined mode of interaction between components, that becomes habitual behaviour, i.e. interaction, which is sensitive to influence and in continuous evolution, in context, can be declined as "rules".

3. *Interaction between components, repeated over time, is consolidated in "relationships" and activate reformulation processes of the same kind*. In substance, within a homogenous environment the rule, intended as application (subjectively interpreted) of the norm (Fig. 7), always takes on new profiles and distances itself from the common denominator as it consolidates itself in time.

Figure 7 – Inter-system stability through laws, norms and rules



Source: personal elaboration, www.asvsa.com.

Law, norm and rule
The *law* is a normative act with which we intend to regulate future behavior of men, typically reunited in "groups" of variable nature and reason, in such a manner to orient specific conduct when certain conditions take place. The set of laws, and thus the systematic organization (that is "the system") of the grouping, constitutes the legal system. In a general manner, the norm is assimilate to a "rule of conduct", or rather to a command, that imposes on an individual a specific behavior.
The *norm* must not be confused with the law in any way. Whilst a law has a statute of limitations, a norm is an applicative consequence of the same. Norms are usually deducible to a specific written linguistic formulation (constitution, laws, regulations etc.) in order to confer to the same a high degree of certainty and duration over time.
With the term *rule* we intend a declination, pro tempore shared, of a pre-established norm, generally codified and coordinated with others in an organic system.

4. As a consequence of the above-mentioned effect, *the emerging system sees a progressive reduction of consonance with the context*, i.e. it loses the capacity to guarantee compatibility between its processes and those of the supra-systems which are relevant to interaction with the system, and assist in the emerging of complexity.

The four points previously mentioned can be better understood by illustrating some founding concepts, of the *Viable Systems Approach* (***VSA***):

- a viable system lives, aspires to and survives, in a context populated by other viable systems;
- context is intended as a "construction of reality" which is operated by the governing body (decision maker) of the viable system considered and inferred in the environment (structure of context intended as macro-system in which at the same time, the structure of the considered system is immersed) by virtue of the objective to be attained;
- a context qualifies itself as being the expression of synthesis for a network of viable systems where a limited number of systems (relevant supra-systems) can be distinguished that are capable of conditioning choices made by the governing body of the system under consideration;
- the structural definition of the system and the level of *consonance* between the evolved components (interacting supra and sub-systems), determines the level of completion of the system considered;
- the viable system adapts (self-regulation) its organizational scheme dynamically and seeks to interpret the signals in context (normative indications) correctly to determine consequent behaviour in order to maintain (subjectively derived rules) and to conserve the level of consonance in context (respond to expectations of the relevant viable systems) and thus preserve its own stability;
- an organizational structure includes many principles, values and beliefs, as well as interpretation schemes, laws, regulations, consolidated methods, habits (routines).

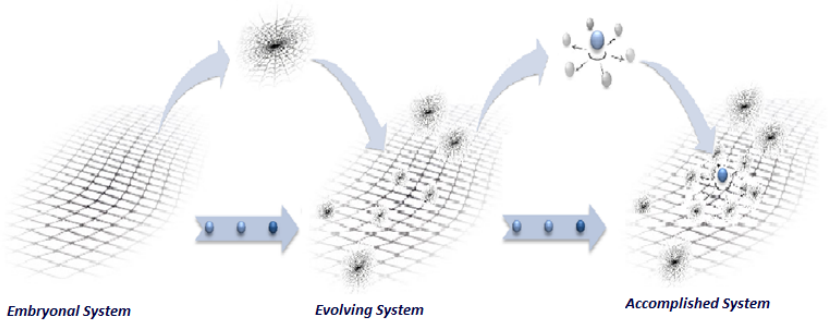
The capacity of the system to interpret norms which are coherent with the context and to codify the relative rule, is strictly correlated to two factors:

1. the level of accomplishment of the system. An accomplished system allows for the channeling of information (reduction of possible *information asymmetry*) to a greater extent compared to what occurs in evolving or in embryo systems.
2. the level of existing consonance between the system components (internally and externally to the structure). An elevated level of consonance facilitates *the realization of "change" pro*cesses useful in the development of resonance between the system and the

context in which it operates.

The *Viable Systems Approach* distinguishes viable system based on different levels of evolution as illustrated in Fig. 8.

Figure 8 – The different levels of accomplishment of viable systems



Source: personal elaboration, www.asvsa.com.

The potential evolution from in embryo to an *accomplished* system can be interpreted through the path whereby shared rules become formalized laws. Within the normality of various cases a set of elements initially disconnected and disarticulated, can form an accomplished system due to the application of a rule. For instance, a case in point would be the people roaming the streets of a large city, observing their route, each taken with their own thoughts and interests, seemingly not sharing anything with others. Yet, when they arrive in the proximity of a crossroad, the mere presence of a traffic light, regulating their route, transforms them into a system crossing the road. The application of just one rule is necessary to allow the emerging of a system. In the same way, a group of economic operators, involved in trading, applying any kind of rule (i.e. a handshake used in the livestock market in the past) becomes an in embryo viable system. The system is defined as in embryo because the rule, established bottom up is not yet formalized, has many levels of flexibility and is subject to the variables that create separate groups. The following phase marking the emerging of *governance* that is shared to a certain extent and capable of formalizing rules, in substance enables the defining of new rules, qualifying the system as *evolving*. The progressive acceptance of formalized rules, the

codifying of the rule, required bottom-up and stipulated top-down, leads to the accomplishment of the system.

However, the above-mentioned evolution is a reversible process. At any time, a reduction of the consonance level, i.e. the progressive decline in attitude toward following codified norms, produces a decline in the system which from accomplished returns to the in embryo stage.

From the debate so far, it is reasonable to assume that once the conditions exist that induce consonance the governing body of the system is able to guarantee stability to a certain extent as it does not have to deal with complexity conditions. At most, in some cases, considering that the instances emerging in the context (forcing the rules) "complicate" consolidated procedures, adjustment processes or, where relevant, the transformation of traditional models and operative schemes need to be addressed.

In cases where governing body realizes it is no longer capable of coordinating the requests expressed by the context (from the supra-systems of reference) the outcome is a progressive emersion of *complexity*.

When the governing body realizes that the performance of the system does not contribute to stabilizing the relations within the context, but rather, strengthens distortion (reduction of consonance) and a progressive growth of uncertainty is noted, the governing body becomes aware both of the inadequacy of its *interpretation schemes* and of the need to derogate from the rule, progressively renouncing consolidated decisional models and finding refuge in occasional heuristics and contingency. The alternative path (selfishly privileging its own interests) would create (dissonance or negative resonance) degenerative and destabilizing processes of the system.

4. EVALUATING VIABILITY THROUGH THE SYSTEMS COMPLEXITY PARADIGM: TWO CASE STUDIES

4.1 The case of the financial system

Recent events affecting national and international financial markets are a good example and illustrate very well what we have delineated above.

The question that has long been debated concerns how such a

disaster was concentrated within the mortgage sector, where loans were granted to people without sufficient collateral (*subprime loans),* determining a rapid growth of complexity (incapacity to understand the developing needs within this context), provoking a massive crisis on the world stock exchange, determining the bankruptcy of numerous credit institutions and financial companies, and forcing the entire financial system to undergo enormous changes.

Is it credible that the insolvency of a total amount of loans *(subprime)* that in total came to only 2% of the entire USA market, could have determined the involvement of everyone? Where are we to look for the reasons and the responsibilities for such a disaster?

To retrace the recent dynamics of the financial market to the methods outlined in this study we must firstly begin from the hypothesis that the "financial market" is a viable system, along with the level of accomplishment we can attribute to it.

It is reasonable to accept that with reference to what took place in the Nineteen Forties, the conference at Bretton Wood (1944) did none other than redesign, in terms of more consonance, and therefore favouring the transformation of an in embryo system into an accomplished viable system, the procedures for monetary politics that were in place in 44 allied Nations. As is well known, Bretton Wood had to consider the epilogue of a formal process of a financial system, activated by an institutional supra-system as an answer to the disastrous events denominated "crisis of 1929". In substance, by taking note of the *bottom-up* system of rules that had been developed over the years in various countries, an agreement plan was imposed to stabilize the exchange rate at a fixed value with respect to the dollar (that at the same time was connected to an equivalent value for gold). Consequently, the dollar was elected as the main currency, allowing for slight fluctuations in other currencies.

Obviously the activities centred on the codification of norms and regulations did not stop. Only a few years later, in order to compensate for the imbalances caused in international payments, the International Monetary Fund (IMF) was created along with the International Bank for Development and Growth (Birs, World Bank). In 1947 the GATT (General Agreement on Tariffs and Trade) agreement was signed and used in line with the IMF and the World Bank in liberalizing the international market.

For our purpose, it can be said that the financial system was considered to be in an *"in embryo phase"* in the years before 1944.

Consolidated *rules* were already existent in the 44 countries participating at the Conference, but there were still no subordinate *norms* in place. Certainly, they existed and presented many similarities, procedures, operative models, and organizational *routines,* however an identifiable orientation with regards to government politics and system management had yet to be commonly shared.

In the years immediately following Bretton Wood the system was qualified as being in the evolving phase. No governing body emerged however, as showing signs of concentration in this direction nor in control of the many types of procedures amongst the most significant generated within the system itself.

The system thus conceived efficiently regulated international economic dynamics and allowed for economic autonomy on the part of each member State, albeit favouring the achievement of common objectives, This system was quite effective right up to the Nineteen Seventies.

Then something occurred, which was probably incomprehensible by virtue of the "knowledge" possessed in that period, that triggered the conditions for the gradual altering of economic balance (the manifestation of which later became financial imbalance). The reasons for such change are identified firstly by the reduction of "consonance" generated between the expectations of supra-systems and the potential for *performance* of the financial system. The roots of the dissonance (negative resonance) process, can be traced to the Nineteen Seventies, a period of massive economic expansion in the United States as well as in most Western European countries. During that time, a "virtual" progressive process was started the aim of which was to diminish inequalities in social classes within the economic system. The shift determined by the transformation of a categorical value, "morality" linked to indebtedness, triggered the explosion of consumption. Many people, even those who were not well off, were induced through legalized persuasion, to purchase goods and services in an ever larger measure, not for real needs, but where the possession of such goods and services was linked to the identity of belonging to a specific group, consequently, social integration and legitimacy. In this environment consumerism (which later would contaminate all the Western nations in a short time) originated.

Consumerism, as a categorical value, is facilitated by and at the same time facilitates the creation and the diffusion of credit

instruments needed for its survival: It introduced distortion, virtual wealth and substituted the pre-existing scheme that tied money to an objective fact: the gold reserve. As pointed out in 1-4 in the previous paragraph, consolidation of distorted rules with respect to the traditional interpretation of norms is clearly evidenced. The outcome is a reinterpretation that imposes a redefinition of the norm which is capable of taking all this into account. It is not by accident, therefore, that president Richard Nixon in August 1971, with the announcement of the *Smithsonian Agreement,* regulated what *de facto* had already taken place: the suspension of the conversion of the dollar into gold (gold exchange standard), initiating the fluctuation of currency exchange.

The euphoria behind the possibility of realizing the American dream short term affected the population at every social level, every age group, and every culture. From that period onward and in the following years a sort of general intoxication was evident.

The dominant interpretation scheme was that of *one best way* as the affirmation of logics connected to individual action where each individual has the opportunity to achieve success on the market as well as personal well-being.

Single systems tend to privilege their own potential for survival even though this might damage the expectation of their supra-systems of reference.

The effects of this trend has produced distortions in two significant directions.

On the one hand, the chronic overproduction of western industrial systems starting from the Nineteen Seventies. An overproduction which contributed to the compressing of workers' salaries, with a consequent shift of wealth towards profits. The drop in the gross domestic product which goes towards work income (*wage share*) and the correspondent increase in the quota reserved for profits *(profit share)* is a common practice (rule) in all the western economies. The setup of the scheme leads wage earners to imagine their own economic perspective as not yet "anchored" to the income capacity from work, but more connected to financial dynamics within an economic and social context. To use a metaphor it is as if indistinctly, entities, institutions, companies, professionals, and wage earners and everyone in general, navigating along a river, distinguishing between transatlantic ships and small boats, are no longer aware of their own capacity for propulsion, relying on the speed of the river itself. The

wage earner, to achieve his objectives no longer confides in his own capacity for rowing, but hopes to be dragged along by the power of the currents.

Given these dynamics, during the same period, there is a sharp increase in "river currents" with the development of financing products and activities that are more and more speculative. Capital is directed in a more consistent manner towards financial markets and less towards productive investments, with the effect of a further subtraction of wealth from the real economy.

In short, a complete destabilization of consolidated rules was the outcome, promoting the progressive displacement of salaries to profits, and in the contemporary displacement of profits into investments to annuities.

Some researchers had already considered what has actually happened: the economist *John M. Keynes,* in 1926 stated that *when the accumulation of capital in a country becomes the under product of activity for a casino it is possible that things will go the wrong way,* he perceived and prophetically denounced liberal ideology, founded on financial capitalism as structurally fragile and exposed to continuous crisis.

The passage from the stability phase to growing instability, that can be explained on the basis of the (***VSA***) approach, occurs through the progressive incapacity of the observed system (financial) to detect, analyze and redirect behaviour from the different supra-systems present in this context.

As a result, in the case of the financial system, in times where things were supposed to move along easily, unusual "events", emergent and unjustifiable within a consolidated system of norms and regulations should really have been predicted.

With hindsight, effective signs of unorthodox behaviour by the components of the system (expressions of relevant supra-systems) were certainly to be found, above all in recent years. Just to mention a few: the Stock Exchange crash in the 1980s, the scandal involving junk bonds in the 1990s and the consequent crisis in American Banks, leading up to the crisis in act.

Nevertheless, neither the governing body nor most of the components of the financial system recognized the signs. They imagined they could deal with the consequences by adjusting and transforming the rules in place. When they found themselves in an extremely complex situation, they responded with heuristic decisions

and behavioural dynamics led by excessive attention (selfishly) addressed to their own (in systems terms) survival. As a result, they caused a sharp acceleration of processes of instability and degeneration of the financial system.

4.2 The case of the healthcare system

In Italy the publicly funded Health Service – the National Health Service (NHS) – (established with the Law 833/1978) based on universal and comprehensive principles and funded by the taxes (Torbica and Fattore, 2005) is closely modeled on the British system. Decision making power is distributed between central Government and the Regions. The Government defines the services that are guaranteed by the public sector (*Essential Assistance Levels* – Livelli Essenziali di Assistenza, LEAs) while the Regions are accountable for delivery. The LEAs framework is the result of what could be considered a *service level agreement* (Katzan, 2008) in the Italian Health Service (Saviano *et al.*, 2009).

With the institution of the *Essential Assistance Levels*, the NHS was committed to providing essential health services Based on safeguarding the values of human dignity, personal health, equal assistance and good health practices (Bernardi and Pegoraro, 2003). In addition to these fundamental aims, Italian legislation (Legislative Decree 502/1992; Legislative Decree 229/1999; Law 405/2001) subsequently imposed targets of efficiency besides those of effectiveness. In particular, with the concept of efficiency, a managerial culture was introduced into the healthcare sector (Zangrandi, 2000; Michelini, 2000) and rational decision-making, inspired by business management, became established practice. As a result, the system has acquired a business-managerial character underpinned by a technical managerial approach.

To interpret the main dynamics of the healthcare system according to the VSA approach the degree of accomplishment we can attribute to the health service as a *viable* system has to be evaluated.

The approach to healthcare has gradually changed the nature of relations in the Italian Health Service, with a shift from a paternalistic healthcare scheme whereby patients submitted to medical treatment in a passive manner, to a contractual assistance scheme in which the patient has become a demanding client. In this sense, there has been

an evolution in structures, services, and needs, as demonstrated by the transition from the original *doctor-patient* relationship to the current *provider-client* relationship, centred on the principle of patient autonomy and a more qualitative customized service (Saviano *et al.*, 2009, 2010).

This change in paradigm could have represented an opportunity for rethinking the entire governance approach in terms of sharing rules and objectives, such as a value *co*-creation scheme. On the contrary, the gradual shift towards business logics and competitiveness has substantially oriented managers to reconcile efficiency with effectiveness (Kongstvedt, 2001). As a result, management has started using models, techniques and tools originally conceived for business organizations, formalizing processes with codes, procedures and protocols, thus determining the overbalance in favour of a technical approach (Saviano *et al.*, 2009, 2010).

The outcome (despite the business management perspective and apart from a significant number of good practices) has been that the Italian Health Service often appears to veer away not only from a value *co*-creation model (Maglio, et *al.,* 2009; Barile and Polese, 2010) but even from effective value creation oriented management. Furthermore, although the widespread waste of resources is commonly recognized, the NHS does not seem to have devised any effective policy to curb or sanction such waste. We are continually witnessing a crescendo of 'inappropriate' practices, often performed within the limits of legality, which offend persons on two counts: as citizens – and even worse – as patients (Saviano, *et al.*, 2009, 2010).

As in other systems, the historical evolution of the managerial approach has progressively become impoverished of its values. Consequently, to date, management would appear to have lost its virtuous dimension which originally legitimated the company-institution as a beneficial instrument for the well-being of society. In particular, some managers have shown little foresight in facing complex *decision making* – fundamental for the survival of the system – tending to use this technical approach of *problem solving* in an attempt to replicate success by repeatedly using common interpretation schemes for every problematic situation.

Moreover, even the ways in which the NHS government has acquainted itself with the principles and criteria of business practice have evidenced the development of a problem-solving oriented approach (Churchill, 1999), often applied in *complex decision making*

contexts (Saviano and Berardi, 2009), where ethical human and societal values are generally involved.

As evidenced, with time, certain practices become habits (Maslow, 1970). Thus, their progressive diffusion in a managerial context has shaped a style of decision making and behaviour mainly based upon economic rationality schemes offering value propositions which cause a non-alignment of consonance with the needs of the client, with the risk of generating instability and failing in the achievement of its health and well-being goals. Especially in healthcare service systems, the nature of *provider-client* interaction is complex, involving and blending not only economic and functional, but also ethical and emotional expectations (Olesen and Bone, 1998).

If it is true that economic aspects have become more important for healthcare providers, clients seem to have gone in the opposite direction (Saviano, 2007). In the past, patients appeared more resigned to accepting illness. Currently, in modern westernized society and as a result of scientific progress, health is considered a primary value, which is protected constitutionally. However, the patient, considered as a client in a more complex relationship does not possess adequate interpretation schemes to assess the effectiveness of the service rationally and tends to make his choice from a *relational* point of view, guided mainly by deep-rooted values based on trust (McColl-Kennedy *et al.*, 2006; Saviano *et al.*, 2009, 2010).

From a (***VSA***) viewpoint, it is clear that healthcare system government, in defining its relationship strategy with external entities, considers the *politico-institutional supra-system* as its main point of reference, relevant to satisfying and guaranteeing *access* to the *resources critical* for its *viability*. The above *supra-system*, given its aims, has projected upon the healthcare system, the recovery of efficiency expectations in terms of reduced spending, establishing behavioural constraints and rules and reward/sanction mechanisms. Added to which, is the fact that healthcare managers are appointed on a politically regulated basis (Saviano *et al.*, 2010).

Therefore, the healthcare system has progressively become more consonant to the expectations of the *politico-institutional supra-system*, consequently considering the *client supra-system* – being primarily interested in the *effectiveness of the service* – as less relevant.

Adopting the proposed complexity paradigm as a general interpretation scheme applied to the healthcare context, it, can thus be

argued that the Italian Healthcare System shows a significant level of dissonance seeing as all the actors involved in the system do not seem to share the same rules, although the regulatory (law) order is well established. All the activities in the healthcare system are centred on rigidly codified norms and rules. Considering the distribution of power in terms of decision making and the territorial configuration of the operative structure, it seems that, just as occurs in a complex *system of systems*, in spite of the aim at working as a unified National system, the main strategic and operative levels are the regions, where significant differences in outcomes clearly emerge.

The NHS is visibly in the "evolving system" stage, however, the trend shows no signals of accomplishment. This is mainly due to the diversity of the aims, expectations and rules of the various parties involved (political-institutional governing body, professional, administrative and technical personnel, and the citizens, both as patients and as users, families, etc.). With the sole exception of the many good medical (and nursery) practices, regarding the doctor-patient relationship, where in spite of high information asymmetry, a good level of consonance emerges, in other relational contexts, a growing lack of consonance is evident at several levels. Thus, the real nature of the *information asymmetry* concept can be grasped: it is not so much a matter of *un-shared information*, but primarily a problem of *dissonant interpretation schemes* and mainly *categorical values*.

In a scenario of general crisis and a growing lack of resources, the growing risk of systemic instability and its dissemination through the entire network is prevalent. Obviously, this situation at the macro level has a negative impact al the micro level, as it exacerbates the relationship not only between the healthcare administration and the users (external context), but also between the administrative and the medical management (internal context), where the dichotomist nature of the roles played emerges clearly.

From a systems complexity perspective, despite its very good reputation as the second best healthcare system in the world and the third best for healthcare performance, the Italian Healthcare System remains an example of a system at significant risk of instability. In this respect, a change in mentality towards logics of integrated effectiveness, efficiency, and sustainability would be highly relevant, where sustainability becomes a key factor for system viability.

5. SOME CONSIDERATIONS

Even though it has been widely debated in different social and business economic disciplines, the issue of complexity is still shrouded in ambiguity in terms of definitions and, often confused with theoretical derivations that are not linked to business theories and managerial strategies proposed in the literature and in practice.

In this context, our study aims to define the boundaries of *complexity* within the realm of the *Viable Systems Approach* (***VSA***) and to investigate the relations between this concept and those of variety, consonance and the level of accomplishment of viable systems.

The first – and the most evident – consideration that emerges consists in the subjective nature of the concept of complexity. The classification of a phenomenon as complex derives from its patrimony of variety – in other words, *information units, interpretation schemes and categorical value* – possessed by the observer, being the governing body of the business, or the researcher. Accordingly, there is a consequent rejection of approaches which aim to "objectify" complexity by reducing it to a mere calculation. As a result, there is a thrust to investigate the role and influence of relations and interactions (with the attached *functional* and *intentional* aspects) between internal and external components of the systems and amongst the latter in the relationship between the company and its context.

Secondly – and by virtue of the above – it might be opportune to underline the cases in which the governing body in a business system realizes that it is no longer capable of coordinating demands which are manifested by its supra-systems of reference, in the progressive emersion of *complexity*. In other words, when the governing body realizes that system performance does not contribute to the stabilization of relations within its context, but on the contrary, disrupts consonance, it takes note of the progressive growth of uncertainty and the inadequacy of its own *interpretation schemes* (rules as the interpretation of norms) and progressively renounces the rational decision making models to find refuge in occasional and contingent heuristics, based on self preservation, selfishly privileging its own needs.

From such dynamics the growth of dissonance between the business system and its context derives, with a consequent change in the governing body's appraisal of the level of comprehension of

emerging phenomena.. There is consequently, a shift from a state of *certainty and/or complication* in the interpreting of instances, towards pressure and opportunity that is qualified in context to what is considered *complexity* ending in a state of *chaos.*

This change in level of comprehension in context is usually accompanied by a variation in the level of accomplishment of the system by virtue of the logics of self preservation on the part of its governing body as well as its components. A weakening in consonance even internally can consequently be seen as a trend towards the "in accomplishment phase" or even, the "in embryo phase". Thus, a mechanism can be set off with regards to growing instability that if not understood adequately by the various systems in context, can further accelerate the diffusion of distorting conductors generating a growing perception of environmental complexity and therefore, the further instability of supra-systems populating it.

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