From Requisite Variety to Information Variety through the Information theory: the management of viable systems.

<Viable System Approach>

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INTRODUCTION

Aim of this paper is to elaborate considerations about the possible existing relations among the theoretical constructs on which the Law of Requisite Variety (Ashby, 1956) and the Information Theory (Shannon & Weaver, 1949) are based and the recent studies on the dynamic of viable systems as a practical assumption for the decision-making processes in business administration (Barile 2009, Golinelli 2010), with particular reference to complex contexts. In Mathematical Theory of communication Shannon and Weaver identify three problematical levels related to the comprehension of a message: the technical problem regarding the accuracy of the message, the semantic problem regarding its comprehension, the effectiveness problem connected to its adoption. Furthermore, the authors specify that their work essentially refers to the first level, that is to the way a correct codification and decoding of the massage can be obtained; however, they clarify that the accuracy of the codification is a binding factor for what concerns the subsequent levels. The notion of "informative variety" (categorical values -strong beliefs-, structures of interpretation, informative units), suggested by the VSA (Viable System Approach), comprises all three levels and contributes, by

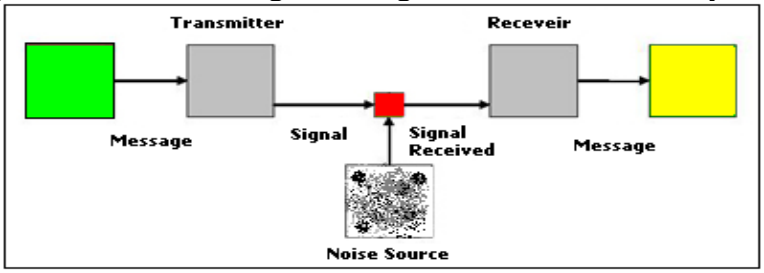
introducing the notion of consonance, to define the condition in which the received meaning can effectively affect the behaviour of the receiving person or not. Moreover, Ashby's notion of requisite variety must be revisited, as it has to include and consider the notions of structures and categorical values suggested by VSA, as well as the notion of consonance. The methods of comparison between the conceptual assumption of the Information theory and the theoretical background of VSA permit to better define the semantic value of notions like entropy, emergence, complexity, et al. The approach used consists in revising the basis of the Information theory and of the requisite variety, in light of the new perspective principles derived from VSA.

For what concerns management and decision theories in complex contests, with particular reference to viable systems, we provide an approach capable to orientate decision maker's choice, giving a useful perspective to the decision makers operating in actual contexts.

1. INFORMATION THEORY, REQUISITE VARIETY AND INFORMATIVE VARIETY.

In *Mathematical Theory of Communication* Shannon and Weaver outline a suitable model to explain how you can get a proper encoding and decoding of the message. In the diagram below, the green box on the left is for the issuer, the yellow one on the right for the recipient.

Figure 1 - Shannon's diagram of a general communication system



Source: Shannon, Weaver, 1949

The uniqueness of the Shannon model consisted in introducing a measure that can define the amount of information from the source to

the recipient. Shannon studies the relationship between information and entropy, using a mathematical theory based on probability theory, applied to systems that can be understood in an imperfect way (Telfener, Casadio, 2003).

It should be born in mind that Shannon and Weaver were aware of the limits of applicability of the model shown above. In particular, the model allows the study of the technical problem of communication (the problem of the precision with which they can transmit the symbols of communication), but not the semantic problem (related to the understanding of the message) and the performative efficacy (connected to the acceptance of the message).

Shannon and Weaver's model has been defined as a *model of postal communication*, and based on what Reddy aims to define the conduit metaphor (Reddy, 1993).

In Shannon's model the context is taken into account when you introduce a reference to the noise source, but it is an interference with respect to a lateral process of transmitting information, themed as linear.

For many years the theory of communication has been tied to the assumption "realistic" the transfer of a message that is as immutable as a package or a solid object in going from one person to another. Only in the mid-fifties we will develop a two-way communication model, in which transmitter and receiver are both committed to send messages to each other, as in a tennis match. Both actors become actors, and the attention moves to the search for a common code. The communication theory will be developed to include its most relevant aspects, including the assumption that the information does not pass easily between two parties but merely to confirm and strengthen existing information structures, thanks to the work of Henri Atlan (1987) will be exceeded then the rigid dichotomy between information and noise, and will be the focal point is no longer the message, but the listener.

Shannon's model is the basis of the theory of *requisite variety* developed by Ashby, this law can be explained both as a relationship between information and selection or as a relationship between a regulator and the regulated system. In terms of the relationship between information and selection, the law of requisite variety says that the amount of selection that can be performed are limited to the amount of information available. Once the observer has exhausted the subject information available, there are more rational reasons to make

the selection. For example, to access certain public contests, candidates are required to present both scholastic qualifications obtained, both grades achieved against the individual concerned. In terms of the relationship between the regulator and the system is regulated, the law of requisite variety says that the variety in the regulator must be equal to or greater than the range covered in the system.

As an example, consider a manager who oversees employees, you must have the human resources manager pays attention to only some of the behaviours of employees. Otherwise, the manager would not be able to control the variety that could cause actual workers.

The law of requisite variety has some important implications. Faced with a complex situation, there are only two choices - increase the variety of the regulator, for example through the recruitment of personnel with high professional skills, or because the observer is to define "the system" through the selection of variables , reduce the diversity of the disciplinary system.

From these considerations it follows that a system is stable if the number of states of its control mechanism is greater than or equal to the number of states in the system to be controlled. In that regard, Ashby says that only variety can destroy variety (Ashby, 1954, 1956). Because, often, the contexts are typically more complex and vital systems as there is no doubt that changing the context is more difficult to change its system, to expand the variety you need to improve their operations and performance when confronted with the complexity (Weick, Sutcliffe, 2010).

Nevertheless, it is common belief, even today, the managerial competence concerns the correct application of the mechanistic view and study Taylorist. Therefore, they can prevail ways of thinking and acting, traditional, based on established patterns, which may even preclude even the possibility of realizing the possible alternative of choice. Not only is it easier to act in the same manner in which he acted in the past analog circumstances, but in a situation of uncertainty, do what has been done before seems to be the safest route and one that involves fewer risks (Katona, 1964). However, human behavior is not always subjected to the constant and detailed guidance of careful and accurate hedonic calculations, but is the product of an unstable and irrational set of reflex actions, of impulses, instincts, habits, customs, mode. The inability to substantiate the problem,

through the interpretive schemes and models used in the past, it coincides with the concept of complexity. This means that to realize the impossibility of achieving the objectives identified, unable, from the perspective of problem solving, to understand where, and what reason, the strategy appears to be not practicable, you must find the capacity to imagine paths evolution towards new skills (Barile, 2010). Starting from a vague and indistinct perception of a turbulent environment and diverse, we come gradually, and through a relentless work of alternating stimuli towards convergence in shared impulses which seek to avoid disagreements for non-compliance with customs and traditions, to a " new order. "

Recent developments in line with developments in information theory, have led to clarify, theorizing the concept of informative variety, the conditions under which information units may or may not induce a change in the receiving subject. In light of these considerations, the notion of requisite variety of Ashby necessarily end up having to be revisited, having to include and consider the concepts of Categorical Values, Interpretive Schemes and the fundamental concept of consonance provided by Viable Systems Approach (Golinelli, 2000, 2002, 2005, 2010, Barile, 2000, 2002, 2006, 2008, 2009).

2. THE ESSENCE OF THE VIABLE SYSTEM: THE INFORMATION VARIETY.

The adoption of the systemic paradigm for the analysis of business phenomena derives from the application of the systemic view, firstly adopted in biology (Bertalanffy, 1968); it revolutionized the field of business economy, going beyond the traditional analytical-mechanistic approach, founded on a cause-effect view (given a cause, there will necessarily be the expected effect). A systemic approach, in fact, puts emphasis on the whole more than on single elements, as the analysis of the single elements, though still considered, can be seen only as a 'reconstruction of the whole' taking into account the principle of interaction which underpins the internal and external relations to a system.

The notion of viable system was introduced for the first time by Stafford Beer (1991), who defined it as a system that *survives*,

remains united and is integral and homeostatically balanced both internally and externally and also has mechanisms and opportunities to grow and learn, to grow and adapt, that is to become more effective in its environment. The notion of viable system theorized by the VSA (Golinelli, 2000, 2010; Barile, 2006, 2009) partly refers to the one by Beer, but with some conceptual innovations. In this approach, in fact, beyond the enalysis of the structural components of a system, more emphasis is given to the interaction between the system and the reference context, as it enables the system to learn, adapt and develop over time (homeostasis) in order to survive. Moreover, the purpose of survival characterizes all the viable systems, that consists in undergoing changes in system's logical and physical elements in order to preserve their ability to survive. Moreover, compared to the approach of Beer, the notion of viable system by VSA gives greater emphasis to the action of the governing body (Golinelli, 2000), which is required to maintain the viability of the system within the context of reference . Therefore, in order to link the definition of viable system to the principles of the enterprise, it is necessary to refer to five postulates which are essential to the existence of a firm conceived as a viable system in terms of VSA (Barile, 2008):

- ✓ *survival*: a viable system has the aim of surviving within the context in which it is inserted;
- ✓ *eidos*: the viable system is characterized by the simultaneous presence of structure and system;
- ✓ *isotropy*: the viable system consists of two areas, that can be represented as "deciding" one and "acting" one;
- ✓ *interaction*: the system interacts, in its dynamic, with supra systems and sub systems from which it draws and to which it provides guidance and rules;
- ✓ *completeness*: for a viable system all the external components are considered viable system, that is referring to another system at a supra level.

Thus it becomes evident that, among the advantages of this notion of a viable system, there is the possibility to interpret and represent more effectively the evolving dynamic of the enterprise, which development processes are increasingly influenced by the need to set up and use effectively the relationships with the multiple entities present and active in its environment.

The importance of the interaction between the viable system and the referring context underlines the characteristic of "openness" that the decision maker must have, in order to recognize problem situations, to identify possible solutions, and to choose the most appropriate path of resolution. The essential element, intended as the set of information resources that can impact on the evolving dynamics of choice, and that orientates the decisions of the decision maker, is defined in VSA as the *information variety* (Barile, 2009) and consists of *information units*, *interpretative schemes* and *categorical values*.

Figure 2 – A representation of Information Variety

Source: Barile, 2009:84

So, making reference to VSA, intended as a theoretical development regarding the dynamics of decision making process, particularly valid in complex contests, we can make a substantial equivalence (isomorphism) between a viable system and an *information variety:* that means that each viable system can be represented by its information variety. Introducing this notion, we can identify what are the likely prospects of creating *consonance* and *resonance*, in order to come to the identification of shared and accepted solutions. Moreover, it implies that, to reach an *effective* communication, it is necessary for the entities belonging to a specific context, to share not only the patterns of interpretation, but also categorical values, that are able to direct the evolutionary path of a specific viable system. In order to better understand how decision

making processes can be oriented by a possessed information variety, here is a brief description of its composing elements (Barile, 2009).

Information units owned by a viable system represent his knowledge, that is everything that he can elaborate and perceive with his senses; a viable system perceive information with its senses, then elaborating them and defining its process of acquiring knowledge. As this process is subjective, it derives that different systems, within the same specific context can elaborate information in different ways. The way a specific information is perceived and elaborated depends on the system's specific *interpretative schemes.* These schemes impact on the way the viable system organizes the perceived information; in essence, they transform generic information in specific ones, connected to the specific context. The third level composing *the information variety*, and its deepest one, is represented by *categorical values*. They can be described as a viable system's system of value, its strong beliefs, having an impact on the nature of the system's interpretative schemes and able to accept or refuse determined elaborations and points of view in general.

The composition of the described information variety determines the possible evolution and orientation of decision making process, with specific reference to the notions of *consonance* and *resonance* (Barile, 2009).

The focus on interaction assumes importance when two different information varieties (representing two different viable systems) interact and modify themselves, orientating the paths of solution during a decision making process. For a decision to be shared and accepted, as said before, the interaction among different information varieties has to stimulate and involve their categorical values, thus creating *consonance*.

These elements put in evidence the incidence of emotional elements in human decisions, that we defined categorical values: each of the viable systems belonging to the specific context of the system of reference has an information variety that is defined and, once identified the "average value" of all the components and particularly of the categorical values owned by each system, it's possible to determine if there is *consonance* among the different viable systems. Maintaining and developing a condition of consonance, there will be a *resonance* among different viable systems (Barile, 2009).

Making a parallelism with the *law of requisite variety* by Ashby, we could say that the possibility of interaction among different viable systems involves a reduction of variety to the "*essential*", that is able to be understood and shared by the different systems and supra systems in the specific context. The law of requisite variety by Ashby (1956) states that the element belonging to the system with the lowest number of connections but which is the most flexible, is the one that mostly influences the behaviour of the whole system. That is, a certain *requisite variety* is necessary to make a system adapt to the evolving context. Moreover, Ashby's *law* also implies that "*only variety can control variety*" (Asbhy, 1956): a system can be controlled only if the *controller*'s variety is at least equal to the one owned by the *controlled*. If we connect Asbhy's *law* to the notion of *information variety*, which underlines the importance of the emotional elements in decision making process, we can understand that flexibility can be achieved only taking into account the categorical values, in order to reach consonance.

3. THE VIABLE SYSTEM MANAGEMENT

What above mentioned allows us to understand how the *Information Variety* of a viable system influences the decision-making process in a given context and determines, given the peculiarities of the information potential of each, the possible prospects of creating *consonance* and *resonance* to reach the formulation of shared and accepted decisions (Barile, 2009).

The evolutionary dynamic of the firm is more and more conditioned by the need to establish and use effectively the relationships with the many entities that are present and active in the environment, so that the decision maker, setting the strategic direction, needs to ensure appropriate mechanisms of integration and coordination of the different operative components, aimed at preserving the unity and integrity of the system (Golinelli, 2000) .

Over the years we have seen the rapid transition from a situation of relative stability, where the risk / uncertainty was always a possibility but however remaining in the background, to a condition where the uncertainty constantly dominates the economic scene,

outlining a setting in which the constant elements are few and placed on a horizon that seems continually to get away.

This uncertainty comes from the high growth over time of the number of relationships between the different actors that have changed the "understanding" ability of the behavioural dynamics of the system. For Herbert Simon (1988), in fact, the complexity is *"a system composed of a large number of parts that interact in a way not easy".*

In consequence from these considerations, it comes out that "the complexity in the social sciences, and then in business organizations, arises when we are forced to give up the structural perspective to evaluate *things*, tangible and intangible, that are uncountable by well known methods and characterized by relational limits that become blurred, related to changing relationships over time and space, and linked to uneven and emergent behaviours. Essentially, the complexity emerges when the interaction, which emerges from any relationship active in a specific process, does not meet well known standards, shared behaviour rules, that is an organizational finalized scheme" (Barile, 2006).

In order to better understand the claims, we can consider the ***historical evolution of organizations***.

At the beginning of the '900 the idea to introduce a method of organizing in *"factory"* was born. The most important proposal was the so-called scientific organization of work (Scientific Management), created in America by Frederick W. Taylor (1911). Taylor believed that it could be "scientifically" determined the *one best way* to do one thing: to gain efficiency it was necessary to design a centralized organization, in which the tasks related to decision and planning of the work were rigidly separated from the ones of execution. Those findings arose from the fact that the problematical area was *simple*, as it is characterized by a minimum number of linear relationships, that is belonging to rational and shared schemes, and then the solution approach was analytical.

Then a new stage begins with the start of mass production. The new technical division of work is organized as a processing chain. The first production line was implemented by Henry Ford (1913) to produce cars in large scale. We pass, therefore, to an *"industrial"* organization designed entirely from the system of machines, to realize a standardized product at a low price to make it accessible to the

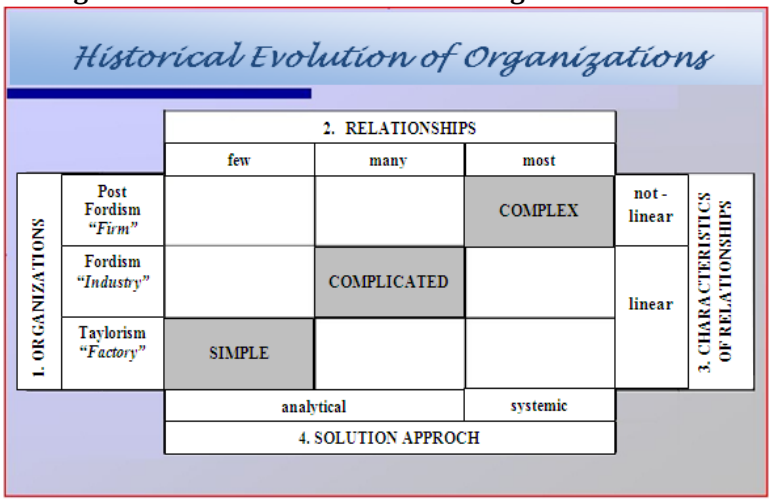
masses. The problematical area becomes less simple (*complicated*), characterized by an increased number of relationships, but always of a structural nature.

By the end of Fordism the "*firm*" was born, marking the transition from a mass production, in a static context, characterized by a low level of complexity, to a mass consumption, in a dynamic context, characterized by an increasing complexity .

In a world where consumers' needs increase, the status of the worker changes and with them the individualism and sense of identity through consumption, the firms have to meet the new requirements, providing variety and diversity in many types of products. We notice that it is difficult to navigate and act using criteria and rules useful before, because the number of components that interact with the firm increases and the many relationships that develop are of limited duration, referring to rules given to a period and build up relationships of relevance in constant evolution.

The modern competitive environment, characterized by dynamic changes, becomes *complex* and requires a systemic solution approach, characterized by a continuous reconsideration of business, strategic and process models adopted by decision makers, so that organizations can continually enrich themselves and shaped by the new and different needs.

Figure 3 – Historical Evolution of Organizations



Source: our elaboration from Barile S. (2009), Sinergie, n 79.

In conclusion we can say that in an environment characterized by dynamism and turbulence, the decision maker is continually called to formulate new interpretive schemes of reality by adapting its information variety to identify the correct path of business.

Since it is clear that changing the environment is more difficult than changing the system, it is possible to improve perceptions and activities increasing Information Variety. Then, the decision maker has to consider that the same problem, that appears in a specific context to different subjects, can lead to different resolving approaches, because of the different Information Variety possessed, but also that the same subject, noting different contexts at different times, may change its resolving approach.

Consequently, as a viable system can meet the challenges posed by the context, it must harmonize its internal diversity with the diversity and complexity outside. The viable systems can answer to changing situations if they have the necessary variety, that can be increased by combination of information in a different way, more flexible and faster.

CONCLUSION

The paper "From Informative Requisite Variety to Variety through the Information theory: the management of Viable Systems" is an occasion to reflect on the value that interdisciplinary research can have in our time. From the relationship among information theory, requisite variety and information variety derives the necessity to clarify the concepts developed above and to distinguish the meanings and scopes, in order to avoid any misunderstandings and difficulties.

Only in this way the dialogue between scientists can be fruitful in a cognitive analytical and interdisciplinary processing, an approach to the reality that explains our existential condition.

The work helps to clarify the distinction between information and knowledge. Bateson said that the information consists of “differences that makes a difference” (Bateson, 1979).

The information, therefore, is closely connected with the interpretive schemes that enable you to decode reality. The information is a necessary factor in producing knowledge (Machlup, 1983).

The information can be seen from a "syntactic" point of view (synthesis schemes), ie in terms of quantity of data transmitted, or "semantic" one (general schemes), ie in terms of meaning.

As we have already seen, an example of the information flow in "syntactic" key is given by Shannon and Weaver (1949).

The semantic aspect is very important in the process of knowledge creation, as it focuses on the meaning conveyed by the message (Nonaka, Takeuchi, 1995).

But while the information is a stream of messages, knowledge emerges from this stream through categorical values of the one who receives the message.

Synthesis schemes	**General schemes**	**Categorical values**
Data	Information	Knowledge

In this sense, knowledge becomes something deeply dependent on the system of values of individuals. In the end, from the perspective of the viable system, information and knowledge are related to a particular context. The viable systems, that interact within a context of exchanging data, share information and thus develop a shared set of information (*consonance*) that has value for them and by which they are affected in their daily activities.

As the study of information processing made it possible to extend a conceptual engine to make it usable as a model for a growing number of human activities, in the same way the concept of information variety is fostering the extension of the validity of laws of those sciences not only to the natural sciences in general, but also to properly human sciences (Somenzi, 1967).

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