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Observing and Interpreting Organizations Through Systemic Perspectives

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Observing and Interpreting Organizations Through Systemic Perspectives

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ABSTRACT

In business studies—as confirmed by most of the studies published in Economia Aziendale Online—the protagonist, whether explicit or implicit, is inevitably the organization, or rather, the concept of organization, interpreted in various contexts. With this short contribution, I will present some definitions concerning the nature and behavior of organizations in general, not only those that constitute companies, observed through systemic perspectives.

Negli studi aziendali — come confermato dalla maggior parte degli studi pubblicati su Economia Aziendale Online — il protagonista, esplicito o implicito, è inevitabilmente l'organizzazione, o meglio, il concetto di organizzazione, interpretato in vari contesti. Con questo breve contributo, presenterò alcune definizioni riguardanti la natura e il comportamento delle organizzazioni in generale, non solo quelle che costituiscono le aziende, osservate attraverso prospettive sistemiche.

Keywords: organization as social systems, organs, objectives in organizations, complex systems, CAS, autopoietic systems, living systems, teleonomic systems, permanent organizations, cognitive systems, structural coupling, control systems in organizations, organizations as intelligent cognitive systems, learning organization, organizations as viable system

We create the world that we perceive, not because there is no reality outside our heads, but because we select and edit the reality we see to conform to our beliefs about what sort of world we live in (Bateson 2000, p. vii).

1 – Introduction

Understanding the world means in fact being able to construct *coherent* and *meaningful* models, which allow us to form and transmit new knowledge. They must be *coherent* in the sense they do not have to be incompatible with our knowledge, that is, in contrast with other models thought to be effective. Models thus represent in a simplified but effective way a part of this reality, and they must be constructed in an *unambiguous language*— adopted in a particular community—using instruments and techniques to communicate knowledge about the phenomena, processes, and entities typical of a given field of inquiry. The language adopted to communicate knowledge requires the formulation of *descriptions* and *definitions* of various kinds—lexical, scientific, operational, logical, etc. *Descriptions* serve to formalize and communicate models for knowledge relating to particular objects of observation or imagination, specifying their relevant dimensions and their qualitative and quantitative determinations. *Definitions* concern the construction of models that specify the dimensions and the permissible ranges of variation such that given objects belong to a given *class of objects* held to be of a similar kind.

For example, we can *describe* "our little dog", "our" car, "our" workplace, "our" galaxy, and so on; it is another matter to *define* "the" little dog (how small must it be?), "the" automobile (how many wheels or what engine displacement can it have?), or "the" concept of a galaxy. However, we can define dark matter, entanglement, or the force of gravity, even though they are indescribable.

> Every man from birth builds models. He builds them from the information he receives from his environment, from his education, and from his experience (Laborit, 1979, p. 34).

> The knowledge that guides human behavior is made up of symbolic mental representations and cognitive activity consists in the handling of these symbols (Edelman & Edelman, 1992, p. 14).

After these brief methodological notes, I will present—within a systemic perspective—some definitions relating to organizations, specifying their typical structures and characteristic behaviors. For a full understanding of organizations, it is appropriate to begin by presenting complex systems.

2 – Complex systems

> *Complex systems are systems in which large networks of components with no central control and simple rules of operation give rise to complex collective behavior, sophisticated information processing, and adaptation via learning or evolution (Mitchell, 2009, p. 13).*

Complex Systems (CSs) will be observed, or defined, as collectivities made up of homogeneous or heterogeneous elements that interact at a micro-level to form dynamic whole, producing a global micro-behavior which—for an external observer—is emerging and not predictable a priori (Kauffman 1993, 1996).

DEFINITION 1/1—COMPLEX SYSTEMS. TECHNICAL DEFINITION. If one agrees with the previous definition, it becomes evident that organizations are "ordered systems"—structures of agents interacting constrained by norms—that can be conceived as units characterized by *observable*, *programmable*, and *controllable* behaviors. Organizations are therefore distinct from *complex systems* or from *complex adaptive systems*, defined as a plurality of similar unorganized elements, or agents—that is, agents not organized according to hierarchical relations or interconnected in network or tree relations—which, acting individually and freely, produce homogeneous or heterogeneous *micro*-behaviors over time (which lead to similar *micro*-effects). To an external observer, such systems seem to produce a macro-behavior and/or a macro-effect that is unpredictable, unprogrammable, and uncontrollable (Strogatz (2024), p. 45). In this sense *complex systems differ* from *organizations* and social systems ("social machines" according to Maturana & Varela 1980, p. 77), which are composed of *organized* *agents* where the individual and collective and behavior is determined by a network of stable relations, that is, "the organization".

The *Complex Systems Approach* is a relatively new field of science studying the behavior of macroscopic collections of units made up of heterogeneous agents—groups of animals that compete for food, populations with different languages living together in the same territory—or homogeneous agents—parasites, pests, viruses, swarms of locusts—that, interacting individually, form dynamic wholes, whose overall behavior may be observable from the outside but is *emerging*, not predictable *a priori*, and not controllable. Such collectivities are defined as "complex systems". The individual (micro) interactions lead to collective phenomena, so-called *emergent dynamics*, which can be described only at higher levels than those of the individual units (Coveney and Highfield 1995).

Murray Gell-Mann (1995) remind us that the meaning of the word *complexity* derives from "plexus", a Latin word that means braided or entwined, from which we derive *complexus:* braided together. Complexity is therefore associated with the intricate inter-twining or inter-connectivity of elements within a collectivity and between the collectivity and its environment (for a survey of different meanings of "complexity", see, for example, Delorme (2001), who gives a formal distinction between complexity and complication.

In any case,

> There is no single unified Theory of Complexity, but several theories arising from various natural sciences studying complex systems, such as biology, chemistry, computer simulation, evolution, mathematics, and physics. This includes the work undertaken over the past four decades by scientists associated with the Santa Fe Institute (SFI) in New Mexico, USA […] (Mitleton-Kelly 2003, p. 24).

> There are three interrelated approaches to the modern study of complex systems: (1) how interactions give rise to patterns of behavior; (2) understanding how to describe complex systems; and (3) the formation process of complex systems through patterns, properties of the system as a whole but not a property of small parts of the Collectivity, allowing its description to be shortened as compared to a list of the descriptions of its parts (NECSI online; Stacey 1995).

DEFINITION 1/2—COMPLEX SYSTEMS. STRUCTURAL AND COMPUTATIONAL MEANING.

> *A non-trivial machine... is a system whose internal state changes as a result of its operations. Since the internal state of such a machine is generally unknown to an observer, its output—for a given input—is unpredictable. The system is complex because it is historically dependent: its future behavior is a function of its past (von Foerster, 2003, p. 288).*

In "composite objects", complexity presents two characteristics, often jointly:

(1) *structural complexity*, when it is impossible or extremely difficult to understand and describe the structure of such objects because they are composed of such a large number of elements that their relations cannot be observed (the human brain, a termite colony, 60,000 spectators in an Olympic stadium, etc.);

(2) *computational complexity*, when we observe a system "*with memory*" and internal states, and with the aim of understanding the dynamics of the outputs as a function of the inputs.

A significant example of "computational complexity" encountered in the observation and description of deterministic input–output systems "*with memory*"—typical of every biological, social, and organizational context—is described by a well-known anecdote. According to this anecdote, Ross Ashby, the famous cybernetician, evaluated the most brilliant graduates in cybernetics who aspired to work with him in his department (this anecdote is drawn from what Ashby wrote in *An Introduction to Cybernetics*, Chapters 2 ("Change and State") and 6 ("The Black Box"); see also Asaro, 2000.) For Ashby, understanding a system of the type [automaton = input–internal states–output] does not consist merely in representing its internal structure; rather, it requires above all describing the dynamics of the outputs as a function of the inputs, given the internal states.

In order to choose the most motivated graduates, Ashby gave them a simple automaton composed of a container with batteries (a deterministic black box) equipped with two on/off switches and two lamps, with very few internal states, asking them to come back the following day, but only if they were able to give a correct description of what happened to the lamps when the on/off switches were set to all the possible combinations. The following day almost all returned. Satisfied, he gave them a second automaton with a higher number of internal states, inviting them to come back after a week if, in the meantime, they were able to describe it. The few who returned received a third automaton, a "machine" more complex that the others, with multiple inputs and a number of internal states. The graduates were asked to come back with a description, this time without any time limits. After many weeks only one returned, and the master, incredulous, asked him if he had completed the description. The persevering candidate dejectedly shook his head and said: «*I don't think it's logically possible to describe this automaton, and I believe no human could succeed in only one lifetime*». Satisfied, Ashby invited him to join his department since the young graduate had understood the insurmountable problem concerning the "complexity" of systems with memory.

The candidate's *answer* clearly illustrates the extreme behavioural complexity of a system with *memory* that produces an incredible number of behavior types [input-states-output] a machine with memory can produce. The extreme *computational complexity* of machines with memory has been well described by Heinz von Foerster (2003, p. 143), the father of "second-order cybernetics", who views a machine with memory – defined as non-trivial – as a *complex system* deriving from the interconnection of machines without memory, or *trivial machines*. His thinking can be summarized as follows: after having defined a machine with memory, or a non-trivial machine, as a complex system deriving from the interconnection of machines without memory, or trivial machines, he proposes to calculate the number of machines with *four inputs* and *four outputs* (a machine of the ABCD type). von Foerster affirms that the calculation goes beyond human capabilities since there are 2^{8192}, that is, 10^{2466} different ABCD machines. If we consider that the age of the universe calculated in microseconds is 10^{28}, this means that if we had a fast computer that could calculate one machine each microsecond, we would need a time period of 10^{2438} times the age of the universe to calculate the number of possible ABCD machines. He concludes with the following ironic recommendation: "*You are strongly urged not to undertake a similar enterprise. You would lose your shirt, your money, and everything else*".

DEFINITION 1/3—COMPLEX SYSTEMS. COMMON MEANING. According to the previous definitions proposed within Complexity Theory, it would be incorrect to classify organizations as "complex systems". When descriptive observational language is used outside the technical paradigm of complex systems (CSs), the attribute "complex" is usually applied whenever we refer to "entities" made up of a large number of components, often heterogeneous in nature, which prove too complicated to be described and understood. The term "complex" is also attributed to apparently simple entities/systems whose functioning, or whose outputs, seem not to follow intelligible dynamics, due to the limited computational capacity of the observer.

This use is very common in business, social, and political studies for "organizations" often defined as complex systems. There is no mistake here: this simply involves using a narrower meaning of complexity, understood as a characteristic of "composite objects" made up of different elements or agents that operate together, as is normally indicated in dictionaries.

> *Complex* (adjective): composed of two or more parts.
> *Complex* (noun): a whole made up of complicated or interrelated parts.
> (Merriam-Webster.com dictionary).
>
> *Complex: Consisting of many different and connected parts*."
> (Oxford English Dictionary, online).

3 – Complex Adaptive Systems and Combinatory Systems

DEFINITION 1/4—COMPLEX ADAPTIVE SYSTEMS (CAS). Alongside the notion of complex systems was the development of the idea of Complex Adaptive Systems (CAS) by Murray Gell-Mann (1992, 1994, 1995).

> Complex adaptive systems (CAS) are systems that involve many components that adapt or learn as they interact (Holland, 1975, p. 20).
>
> A complex adaptive system acquires information about its environment and its own interaction with that environment, identifying regularities in that information, condensing those regularities into a kind of 'schema' or model, and acting in the real world on the basis of that schema (Gell-Mann, 1994), p. 17)
>
> The term Complex Adaptive System is used here to also refer to *Complex Evolving Systems*. The following extended definition will be adopted:
> Definition (1): A complex adaptive system (CAS) consists of non-homogeneous, interacting adaptive agents. Adaptive means capable of learning.
> Definition (2): An emergent property of a CAS is a property of the system as a whole which does not exist at the individual elements (agents) level. Typical examples are the brain, the immune system, the economy, social systems, the ecology, insect swarms, etc.
> Therefore, to understand a complex system one has to study the system as a whole and not to decompose it into its constituents. This totalistic approach is against the standard reductionist one, which tries to decompose any system to its constituents and hopes that by understanding the elements one can understand the whole system (Ahmed et al., 2005, pp. 1–2).

The CAS, although based on the concept of a complex system, differ from these because they are made up of independent agents that exhibit forms of learning over time, allowing them to adapt both to changes in individual behaviour and to environmental mutations (e.g., viruses mutations).

> Now how does a complex adaptive system operate? How does it engage in passive learning about its environment, in prediction of the future impacts of the environment, and in prediction of how the environment will react to its behavior?
> [...] The answer lies in the way the information about the environment is recorded. In complex adaptive systems, it is not merely listed in what computer scientists would call a look-up table. Instead, the regularities of the experience are encapsulated in highly

compressed form as a model or theory or schema. Such a schema is usually approximate, sometimes wrong, but it may be adaptive if it can make useful predictions including interpolation and extrapolation and sometimes generalized to situations very different from those previously encountered. In the presence of new information from the environment, the compressed schema unfolds to give prediction or behavior or both. (Gell-Mann, 1992, p. 10).

Here we confront directly the issues, and the questions, that distinguish CAS from other kinds of systems. One of the most obvious of these distinctions is the diversity of the agents that form CAS. Is this diversity the product of similar mechanisms in different CAS? Another distinction is more subtle, though equally pervasive and important. The interactions of agents in CAS are governed by anticipations engendered by learning and long-term adaptation. (Holland, 1995, p. 93).

DEFINITION 1/5—COMBINATORY SYSTEMS. Following the previous definition, Complex Adaptive Systems are composed of agents that learn, that is, they progressively modify/adapt their *micro behaviors* according to the evolution of the system, producing a macro behavior that appears *emergent*.

The hallmark of a complex system is that it can exhibit a collective behavior that is not easily predictable from the behavior of its individual parts (Strogatz, 2024, p. 45)

Emergence is the appearance of properties or behaviors in a system that are not present in its individual parts... the most important point is that these properties emerge from the interactions among the parts (Mitchell, 2009b, p. 13).

One of the fundamental mechanisms that, starting from the micro behaviors of the agents, produces a macrobehavior (evolution) that tends to an understandable and predictable order, even if not always predictable, is the one produced by the Combinatorial Systems (Mella, 2025) of which I limit myself to referring to two basic definitions (for more, Mella, 2025).

A collectivity is defined as a plurality of similar unorga-nized elements, or agents—that is, agents not organized according to hierarchical relations or interconnected in network or tree relations—that, acting individually and freely, produce analogous micro behaviors over time (which lead to similar micro effects), but considered together are capable of developing a macro behavior, and at times a macro effect or a recognizable pattern, which is not included in advance in the operating program of the agents' behavior, but is instead attributed to the collectivity as a whole (Mella, 2025, p. 6).

A "combinatory system" is defned as any collectivity (see Def. 1) made up of a plurality of unorganized similar agents (or elements) producing analogous micro behaviors and showing, as a whole, a macro behavior and/or a macro effect, whose dynamics are created by a micro-macro feedback action. If, on the one hand, the macro behavior of the system, as a whole, derives from the combination, appropriately speci!ed, of the analogous behavior (or effects) of its similar agents (hence the name combinatory system), on the other hand the macro behavior (or the macro effect) determines, conditions, or 1.1 De!ning Combinatory Systems 10 directs the subsequent micro behavior, according to a feedback relation between the micro and macro behavior or effects (Mella, 2025, p.9).

4 – Organizations

None of our institutions exists by itself and as an end in itself. Every one is an organ of society and exists for the sake of society. Business is no

> *exception. 'Free enterprise' cannot be justified as being good for business. It can only be justified as being good for society (Drucker 1974, p. 40).*

DEFINITION 2/1—ORGANIZATION AND STRUCTURE. An organization is a "social system", or social structure, formed when a multitude of individuals, or agents in general, for their own particular motivations, agree—voluntarily or by contract—to be part of typical organs bound by organizational relationships and stable structural ties. These relationships and *structural ties* require them to carry out *specialized*, *coordinated*, and *cooperative* behaviors to perform processes that are steadily directed toward a common *goal*, in compliance with *objectives*, programs, rules, and responsibilities that are imposed as behavioral constraints (Cyert & March, 1963; Mella, 2021, p. 466), thereby becoming elements of the organizational structure they constitute and of the network of processes they produce.

This definition applies to all organized behavior, even in the "animal kingdom" (primates, ants, termites, beavers, wolves, humpback whales, etc.). However, I want to limit my considerations only to social and business organizations whose elements are individuals who form a system or a structure of constraints and, in addition to their individual *objectives*, also pursue a *goal*, a shared common vision.

Stable *structural ties* specify the following five elements for each organ or unit, independently of their "nature":

(i) a precise spatial and temporal *placement* of the organs within a hierarchy (topology), which constitute the 'structure' of the organization;

(ii) a specialized *function* of the units, necessary to achieve the "macro" function of the entire structure;

(iii) a specific *functionality* that delimits the utility and the admissible interactions among the organs to permit the functioning of the entire organization and its interactions with the environment;

(iv) a series of *functional standards* for each class of organ (in relation to their nature and knowledge);

(v) a structure of *Control Systems* for the behavior and performance of organs and their micro-processes; control presupposes a manager who sets objectives at every level and plans the behavior and operations needed to achieve them, identifies any deviations between planned and actual behaviors and operations, and determines the corrections to be made.

Organizations can be observed by considering either their constituent elements or the relationships that make the behavior of those elements unified. The first form of observation, focused on the components, is well developed by March and Simon (1958):

> Organizations are assemblages of interacting human beings and they are the largest assemblages in our society that have anything resembling a central coordinative system [...]
>
> The high specificity of structure and coordination within organizations – as contrasted with the diffuse and variable relations among organizations and among unorganized individuals – marks off the individual organization as a sociological unit comparable in significance to the individual organism in biology (March & Simon, 1958, p. 4).

According to Etzioni (1964):

> Organizations are social units (or human groupings) deliberately constructed and reconstructed to seek specific goals (Etzioni, 1964, p. 3).

Stafford Beer (1980) identifies the organization as the binding system of relationships that link the constituent elements, regardless of their nature:

> The relations between components that define a composite unity (system) as a composite unity of a particular kind, constitute its organization. In this definition of organization the components are viewed only in relation to their participation in the constitution of the unity (whole) that they integrate. This is why nothing is said in it about the properties that the components of a particular unity may have other than those required by the realization of the organization of the unity (Beer 1980, p. XIX; preface in Maturana & Varela, 1992).

> A unit realized through a closed organization of production processes such that (a) the same organization of processes is generated through the interaction of their own products (components), and (b) a topological boundary emerges as a result of the same constitutive processes. (Zeleny 1981, p. 6)

DEFINITION 2/2—ORGANIZATION AS PROGRAMMABLE, AND CONTROLLABLE SYSTEMS. However, they are observed, organizations are ordered, programmable, and controllable systems. Through the network of stable relations among its organs, the organization is able to provide constraints to the behavior of its constituent agents in order to produce, at the various hierarchical levels, a network of coordinated and cooperative processes for the achievement of a common or an institutional goal; for this purpose the organization carries out the activities and operations needed to interact with its environment and achieve the objectives established by the governance in order to satisfy the interests of parties outside the organization: the stakeholders.

Therefore, there are four types of *objectives* that individuals pursue through organizations:

(1) *Internal individual objectives*, for which individuals are willing to participate in the organization, accepting its constraints and rules (for example: altruism, compensation, work-related interest, etc.).

(2) *Internal common* objectives, or *institutional objectives*, that is, the purposes for which the organization was created.

(3) *External individual objectives*, meaning the benefits that individuals derive from the organization (for example: remuneration, enjoyment of the results, etc.).

(4) *External common* objectives, or *social objectives,* meaning the benefits that the environment receives from the organization's behavior (for example: reduction of needs, diffusion of well-being, increase in quality of life, etc.).

The *micro-processes* activated and implemented by individuals within the organs of the structure are composed of broader processes—according to technical and organizational rules—which tend, themselves, to regenerate recursively over time, until they form a *macro*-process—attributable to the organization as a unit—that transcends the *micro*-processes implemented by the bodies, even if it presupposes them. This *macro*-process represents the emerging result of the network of *micro-processes*.

5 – Organizations as Autopoietic Systems and Cybernetic Open Systems

[…] an autopoietic machine continuously generates and specifies its own organization through its operation as a system of production of its own components, and does this in the endless turnover of components under conditions of continuous perturbations and compensation of perturbation (Maturana & Varela, 1980, p. 79).

DEFINITION 3/1 – ORGANIZATIONS AS AUTOPOIETIC SYSTEMS. Organizations as "*autopoietic systems*", in the sense that they survive as long as they manage to maintain stable the network of typical processes developed by the organs according to their organizational constraints, replacing the outgoing agents and inserting new ones that maintain the structure. As long as they can repeat this cycle, organizations remain *viable*. In this sense, organizations can, in all respects, be seen as *autopoietic machines*, and therefore *homeostatic* in line with the conception of Maturana and Varela.

Organizations are therefore viewed as "organizationally closed" cognitive systems that develop a continuous cognitive process which produces "representations" of the external environment through a system for "data collection" and the transformation of this data into coordinated "information" and "decisions" necessary for interaction with the environment.

As an *autopoietic system* the organization *reproduces itself* by seeking in the environment the *metabolic* and *energetic* inputs useful for *autopoiesis*, while avoiding harmful inputs. In this way, the organization self-organizes and continuously "reproduces itself" to prolong its *collective life* beyond the "life" of its individual components. For this reason, organizations develop *metabolic processes* that maintains, strengthens, and improves the structure over time by continuously regenerating the processors (organs) and the network of processes that form the "organizational fabric".

The network of internal processes preserves the organizational relationships among the "organs", despite changes in the individuals who compose them; in this sense, organizations are *living autopoietic systems* (Varela, 1979; 1981, p. 38; Uribe, 1981, p. 61).

> If living systems are machines, [then the fact] they are physical autopoietic machines is trivially obvious: they transform matter into themselves in a manner such that the product of their operation is their own organization. However, we deem the converse is also true: a physical system, if autopoietic, is living. In other words, we claim that the notion of autopoiesis is necessary and sufficient to characterize the organization of living systems. (Maturana & Varela 1980, p. 82).

> Autopoietic systems are those systems that produce the elements of which they consist through the elements of which they consist (Luhmann, 1995).

The organization (in particular, the firm), as a living system, is masterfully described by Salvatore Vicari in an innovative work titled *L'impresa quale sistema vivente* (Vicari, 1991; contra: Varela, 1981), and by Arie de Geus in his well-known book *The Living Company: Habits for Survival in a Turbulent Business* (2002; see also 1988), which emphasizes the teleonomy of the organization (section 3).

From the autopoietic perspective, organizations are, in fact, closed systems that receive stimuli or perturbations of various kinds from the environment, which the internal structure processes, "responding" with appropriate reactions and self-regulating to maintain their vital equilibria. Alongside autopoiesis stands the conception of organization as an open system that self-regulates, that is, as a cybernetic system whose self-maintenance depends on its through-output of resources from the environment.

DEFINITION 3/2 – ORGANIZATIONS AS CYBERNETIC OPEN SYSTEMS. From the perspective of cybernetics, an organization can be viewed as an "open system" as its self-maintenance depends on its capacity to control the input-transformation-output dynamics of resources from the environment. This process of system-environment exchanges and controls is essential to the organization's viability since it reduces entropy and allows the organization to maintain its structure over time.

> … general systems theorists elaborate the distinction between closed and open systems by employing the concept of entropy: the energy that cannot be turned into work. According to the second law of thermodynamics, all systems spontaneously move toward a state of increasing entropy - a random arrangement of their elements, a dissolution of their differentiated structures, a state of maximum disorder. Open systems, because they are capable of importing energy from their environment, can experience negative entropy, or negentropy. By acquiring inputs of greater complexity than their outputs, open systems restore their own energy and repair breakdowns in their organization. Bertalanffy concludes, 'Hence, such systems can maintain themselves at a high level, and even evolve toward an increase of order and complexity' (Scott, 1992, pp. 83-84).

Organizations can survive for a long period in a dynamic environment only if they possess internal *regulation mechanisms* that maintain their processes over time even when these are "disturbed" by external variables. Recalling Norbert Wiener's statement that Cybernetics is the science of the study, design, and simulation of "*control and communication in the animal and the machine*" (Wiener, 1948), we hold that "organizations", due to their intrinsic nature as "self-regulating systems", can in fact be observed as *cybernetic systems* that are "self-controlled" to remain vital and carry out the processes for which they were created.

> In giving the definition of Cybernetics in the original book [Cybernetics], I classed communication and control together. Why did I do this? [. . .] When I communicate with another person, I impart a message to him [. . .] Furthermore, if my control is to be effective I must take cognizance of any message from him which may indicate that the order is understood and has been obeyed. [. . .] When I give an order to a machine, the situation is not essentially different from that which arises when I give an order to a person. [. . .] Naturally there are detailed differences in messages and in problems of control, not only between a living organism and a machine, but within each narrower class of beings (Wiener 1954).

6 – Organization as Teleonomic Systems

DEFINITION 4 – TELEONOMIC SYSTEMS. AN organization is a "teleonomic system" that *sets goals*, insofar as it maintains its own autopoiesis by carrying out "cognitive processes" to seek the conditions that allow individuals to benefit, directly or indirectly, from the achievement of a common purpose that defines its teleology: *"[I]n effect teleonomy is teleology made respectable by Darwin*". (Dawkins 1982, cited by Barrows 2001, p. 705).

The concept of "teleonomy" was proposed by Jacques Monod in his well-known work *Le Hasard et la Nécessité* (1970). After emphasizing that all living (autopoietic) beings are oriented toward fulfilling some existential project, Monod specifies that:

> We arbitrarily choose to define the essential teleonomic project as consisting in the transmission, from one generation to the next, of the unvarying contents characteristic of the species. All the structures, all the performances, all the activities which contribute to the success of the essential project will thus be called "teleonomic". … Rather than refusing to accept this idea (as some biologists have tried to do), it is instead indispensable to recognize it as being essential for the definition of living beings themselves. We can say that the latter are distinguished from all other structures of systems in the universe by this property that we will denote as teleonomy. (Monod 1970, pp. 22–25).

This means that all living organisms—for example, plants, human beings, institutions, and production-oriented organizations—as permanent, natural, or artificial organizations, are characterized by a direction oriented toward the existential project that defines them

(Binswanger, 1991). In particular, since human action is intentional and directly oriented toward a conscious existential project, it follows that organisms/organizations engage in "continuous learning" to maintain their autopoiesis (Bandura & Cervone, 1986; Latham & Locke, 1991; Tocino-Smith, 2021), and they believe that "rational" behavior is more effective than behavior they consider "non-rational" (Locke & Latham, 1990). Rational behavior (or "self-efficacy") is influenced by ability, experience, training, past successes, internal attributions, and information about strategies for performing tasks (Bandura, 1982; Hollenbeck et al., 1989).

If we consider "teleonomy" as the tendency of an organization to maintain its own existence by regenerating its autopoietic processes, which have been altered by unforeseen environmental disturbances (Laprie, 2008), thereby displaying a certain degree of "resilience," then we can distinguish between:

a) *Endogenous teleonomy*, which depends on the ability to pursue internal objectives—that is, to develop a teleology in the traditional Hegelian sense of intentional activity directed toward an "End" (Dennet, 1988; Van de Ven & Poole, 1995). In other words, it concerns achieving a common goal and satisfying individual internal motivations. An organization exhibits a high degree of *endogenous teleonomy* if it continues to exist despite unfavorable environmental structural disturbances by developing *adaptive* processes; it is characterized by high exogenous teleonomy if the environment itself provides conditions that favor its autopoiesis, and therefore its long-lasting existence, both as a unit and as an organizational type (Toffler, 1985).

b) *Exogenous teleonomy,* which characterizes the environmental dynamics of the organization and depends on the fact that the organization is valued by individuals who are not part of it, but who derive external—individual or social—benefits from its existence (Monod, 1970, p. 124; contra Maturana & Varela, 1980; 1987; Brooks & Wiley, 1986; Mayr, 1989).

We can also discern the relationships between "teleonomy" and "autopoiesis," in the sense that teleonomy may be understood as the *self-preservation* of a species, whereas autopoiesis may be understood as *self-production* aimed at maintaining the existence of each individual as well as that of the organization itself (Mella, 2021).

With regard to *lifespan*, we may define as *permanent*, or *autopoietic*, *organizations* those whose *life* is not predetermined (*unlimited*). In such organizations, the common purpose is aligned with individual objectives (Paetau, 1997; Mella, 2021).

7 – For-Profit and Not-For-Profit Organizations

DEFINITION 5 – PROFIT ORGANIZATIONS. A "permanent organization", whose common goal is the production of goods and services through a network of instrumental processes that transform *inputs* into *outputs*, is a "production-oriented" organization. A "production-oriented" organization whose operational program leads it to pursue maximum economic efficiency—seeking the greatest possible gap between average unit production costs (to be minimized) and average selling prices (to be maximized)—is a "for-profit organization". If this is not the case, it is a "not-for-profit organization". An organization that "finances" its economic processes with external capital, in the form of *equity capital* and *debt capital*, is a "capitalist enterprise".

The capitalist enterprise bases its *autopoiesis* on its *ability to regenerate its financial and economic circuits*. A permanent organization, whose common objective is the consumption of goods and services by its members, is a "consumption-oriented organization", in its various forms.

For profit organizations, therefore, autopoiesis implies achieving a high degree of both endogenous teleonomy—involving the pursuit of internal conditions for survival through an optimal mix of creativity, productivity, and an adequate incentive system—and *exogenous teleonomy*, which ensures the external conditions for survival and an increase in customer/consumer satisfaction. In this case, such satisfaction is obtained through the optimal mix of quantity, quality, variety, and prices, as well as through social satisfaction, derived from the value of the organization's social impact as perceived by stakeholders (such as job creation, increased average income, tax payments, environmental stewardship, etc.).

8 – The Permanent Organization as a Cognitive System. Structural Coupling

DEFINITION 6 – ORGANIZATIONS AS COGNITIVE SYSTEMS. A permanent organization—whether profit or non-profit—must be understood as a *cognitive system*, because it must, and can, develop processes capable both of perceiving stimuli and assigning them meaning (as "external" or "internal", "favorable" or "unfavorable") and of transforming them into "dynamic representations" of the *internal* or *external* environment. On the basis of these representations, decisions are made and programs are designed and carried out, with the aim of maintaining the organization's autopoiesis by developing *reactive* behaviors (based on causes) and *proactive* behaviors (based on objectives) in response to environmental dynamics.

For an external observer, a *cognitive system* appears as a system *structurally coupled* with the environment, since its structure and actions influence those of another system, and vice versa. In organizations, structural coupling is observed when, through appropriate control systems, individuals and organs (or the organization and other organizations) interact and mutually influence one another, leading to reciprocal adaptation and change (Maturana & Varela 1980, pp. 119–120).

Systemic structural coupling therefore implies the presence of "internal organs" that generate *cognition* and *preferences* within the system, and that successfully connect *with* and *within* the environment to "survive" while maintaining the system's "identity"—that is, the organization of its autopoietic processes—even as the system itself modifies its own structure (Von Krogh & Roos, 1995). In this sense, permanent organizations, understood as *cognitive systems*, are normally qualifed as *complex systems* in the sense indicated in Definition 1-3 (Section 2).

From this perspective, the permanent organization not only adapts to environmental conditions but also develops the ability to learn from experience, continually updating its operational strategies. This process of organizational learning makes it possible to anticipate changes and respond more effectively to external challenges, thereby strengthening its autopoiesis and its ability to maintain internal coherence despite the complexity and dynamism of the environment.

Both living beings and permanent organizations are not only autopoietic systems; they can also be considered (by an external observer) as *conscious cognitive systems*, since—with internal organs for memory, computation, and evaluation (preferences)—they connect to the *environment* through a *system* of processed, updated, and evaluated *information* that we can define as the "representation of the external world" (Terreberry, 1968), on which they base their actions (Hejl, 1984).

From these definitions it follows that, if a permanent organization must be structurally "connected" to the environment, its structure must at least include:

1. *Sensory interface* organs, through which the system connects to the environment to perceive environmental stimuli, that is, the data (signs, signals) that are structured into cognitive "models";
2. *Internal sensory* organs to perceive vital parameters, in particular stimuli indicating imbalances in the autopoietic network (needs, quality, productivity, etc.);
3. *Attention* organs to *select* and *store* stimuli and transform them into meaningful information for constructing representations of the environment;
4. *Computational* organs (computational system) to systematize information and create or modify representations of the environment;
5. Organs for *comparison* and *evaluation* (weights) of information and representations;
6. *Effector* organs to intervene in the environment (or in the niche in which the organization exists), seeking adaptation and producing coordinated actions within the activities that make up the processes;
7. *Control* organs to eliminate any form of structural decoupling, both inside and outside the system (Mella, 2021, p. 471, Fig. 9.3).

However, *cognition* is formed—understood as the construction, use, and modification of cognitive models—every action carried out by a *permanent organization* can be triggered either by *causes* or by *objectives* and can be constrained by *limitations*. Behavior *depending from causes* is typically *reactive*; behavior that has a *purpose* is *proactive* (Mella, 1997).

9 – The "System" of Control Systems as a Condition for the Structural Coupling of the Organization

[…] the autopoietic behavior of an organism A [structurally coupled with organism B] becomes a source of perturbation for organism B; the compensatory behavior of organism B acts, in turn, as a source of perturbation for organism A, whose compensatory behavior again acts as a source of perturbation for B, and so on, recursively, until the coupling is interrupted" (Maturana & Varela, 1992, p. 82).

DEFINITION 7 – THE NETWORK OF CONTROL SYSTEMS FOR ORGANIZATIONAL BEHAVIOR. If we accept the preceding framework, it becomes clear that the existence of every organization is conditioned by a network of organizational Control Systems designed to produce an "alignment" among the people who make up the organization and among its different units. This network ensures that their actions, functions, positions, tasks, and objectives remain coordinated and cooperative over time, which is a necessary condition for the lasting maintenance of mutual structural coupling.

> "Control is the process of directing, influencing, or determining the behavior of someone else" (Lawler, 1976, p. 1248).

> "Control refers to any process through which a person, a group of people, or an organization of people determines, or intentionally influences, what another person or group or organization will do" (Tannenbaum, 1962, p. 238).

Thanks to the Control Systems of individuals and organs that compensate for the effects of environmental disturbances, the organization becomes an "autonomous system", capable of maintaining a stable "structural coupling" with the environment and regenerating the autopoietic network of processes and organs. The autopoiesis of the organization depends on the efficiency of four levels of control systems:

1. The control systems that regulate the *structural coupling* of individuals within the organization based on organizational constraints; I call these Autopoiesis Control Systems.
2. The control systems that ensure the *efficiency*, *effectiveness*, and *balance* of the operations, activities, and micro-processes that constitute the autopoietic network; I call these Homeostasis Control Systems.
3. The control systems that ensure the *effectiveness* of the macro-processes that generate inputs, outputs, and shape the results of the organization as a whole; I call these Teleonomy Control Systems of the organization, since they ensure that outputs and results meet stakeholder requirements, which represent the highest vital constraints for achieving institutional purposes.
4. The control systems that ensure the effectiveness of the *performance* of agents, organs, and of the entire organization.

These four types of control systems correspond to the traditional four forms of organizational control: (a) *personnel* control, (b) *action* control, (c) *results* control, (d) control of the *performance* of people and processes.

10 – The Behavior of the Permanent Organization as an Intelligent Cognitive System

DEFINITION 8 – BEHAVIOR OF ORGANIZATIONS AS COGNITIVE SYSTEMS. From a business perspective, the "permanent production-oriented organization"—whether profit or non-profit—can be conceived as an *efficient cognitive transformer* of *representations* of the environment (its cognitive base) into *decisions* and *plans*, producing a recursive dynamic, representing the organization's behavior. This occurs through continuous feedback between acts of *thought* (entrepreneurial planning and managerial control) and *actions* directed toward the environment (institutional activities), which leads the organization itself toward the continuous change of its position as perceived in the environment and the progressive expansion of its cognitive base, on which subsequent actions depend.

Representations are assigned *weights*, or *preferences*, arranged in a dynamic system usually structured in levels, which influence actions because they select (classify based on a value) the information that the cognitive system considers useful for survival. The highest level of the weighting system within the organization, from which the lower levels derive, is defined as the *value system*, or *ethical system*. A *system of knowledge* and representations to which a system of weights is associated is defined as a *cultural system* (Hampden-Turner, 1990).

DEFINITION 9 – ORGANIZATIONS AS INTELLIGENT SYSTEMS.

> *Intelligence, as defined in standard dictionaries, has two rather different meanings. In its most familiar meaning, intelligence has to do with the individual's ability to learn and reason. It is this meaning which underlies common psychometric notions such as intelligence testing, the intelligence quotient, and the like. In its less common meaning, intelligence has to do a body of information and knowledge. This second meaning is implicated in the titles of certain government organizations, such as the Central Intelligence Agency in the United States, and its*

> *British counterparts MI-5 and MI-6. Similarly, both meanings are invoked by the concept of social intelligence. [...] referred the person's ability to understand and manage other people, and to engage in adaptive social interactions. More recently [...] social intelligence [is used] to refer to the individual's fund of knowledge about the social world (Kihlstrom & Cantor, 2000).*

As an observational and operational unit, a permanent organization, to maintain its autopoiesis, must produce "intelligent behavior" based on a continuous process of learning and on the development of experience among individuals, organs, and the unified structure. A permanent organization in which there is the highest degree of "pooling" of individual intelligence—so that all individuals collaborate to learn together and, above all, to learn how to develop a shared learning process—becomes a *learning organization* (Senge, 2006; Rheem, 1995): a unified, organized, and autopoietic system capable of learning not only to maintain its existence in a dynamic environment, but also to anticipate changes, improve its performance, and evolve by increasing the chances of its own long-term survival.

The "intelligence of the organization" is the ability of the cognitive system, on the one hand, to acquire and use knowledge to make rational decisions, develop programs that are compatible with the structure and appropriate in terms of available resources, act in a manner consistent with those programs, and carry out effective performance controls, aiming to achieve the greatest possible "existential success" without reducing survival options (Drucker, 1989; Gephart et al., 1996). On the other hand, it is also the ability of its components to build a *shared experience* (Kock et al., 1996, 1997), thereby developing a *continuous learning process*—that is, the formation, accumulation, structuring, and self-confirmation of *knowledge*—so as to expand *experience* (training) and use it (application) to improve values, evaluation criteria, decision-making and planning processes, and control procedures (Boland & Tenkasi, 1995; Argyris, 1977; 1992; Walsh, 1995).

The *intelligent behavior* of a permanent organization manifests itself in four main forms:

a) *Automatic behavior*: this is unconscious behavior that depends *entirely* on *operational experience* and accumulates directly in the system's past history.

b) *Adaptive and conscious behavior:* this is carried out through the constant use of conscious attention and relies on *behavioral experience* as well as *operational experience*. Operating through *feedback*, it seeks to identify and correct errors in order to maximize the organization's *efficiency*.

c) *Exploratory behavior*: this seeks to anticipate errors to avoid and prevent them. It cannot rely on direct operational experience and is predominantly *feed-forward*.

d) *Generative* (or *innovative-creative*) *behavior*: acting in a feed-forward manner, it "seeks to create errors" that can be transformed into advantages, and to break free from models and formal representations stored on the basis of elements generated by the cognitive base itself (ideation, invention). In this way, the teleonomic conditions of survival are strengthened.

11 – Intelligent Organizations. The Learning Organization

> *The ideas set forth by organismic biologists during the first half of the century helped to give birth to a new way of thinking—"systems thinking"—in terms of connectedness, relationships, context. According to the systems view, the essential properties of an organism, or living system, are properties of the whole, which none of the parts have. They*

> *arise from the interactions and relationships among the parts (Capra 1996, p. 30).*

DEFINITION 10/1 – INTELLIGENT ORGANIZATIONS. A necessary and sufficient condition for an intelligent cognitive system **i**s that it is able, with its own cognitive processes, to build representations of the world, i.e. descriptions, concepts, uniformity and laws, and to develop a formal communicative behavior through which it extends the range of structural couplings that favors its existence. The cognitive activity of organizations considered intelligent cognitive systems, can be specified in *entrepreneurial* and *managerial* "thinking" (Mella 2009; Beer 1989).

These forms of "thinking" differ according to how intelligent behavior is formed and applied.

(A) ENTREPRENEURIAL THINKING (or innovation) produces policies, strategies, and plans that guide management in carrying out productive, economic, and financial activities. It steers the system by:

a) assessing the firm's competitive position within its environment through strategic dimensions such as products (quality and service), markets (customers and pricing), distribution channels, and internal factors including processes (productivity and cost), technology, and organizational structure;

b) fostering innovative and creative thinking aimed at transforming and improving the firm's competitive position;

c) defines the desired competitive position using strategic vectors;

d) translates this desired position into specific goals that represent target outcomes;

e) identifies the actions required to achieve these goals, namely the firm's strategy for altering its competitive position;

f) operates with a feedforward, strategic orientation, guiding the organization from its current state toward a future strategic position while reshaping the efficiency matrix;

g) adopts an exploratory and innovative approach, experimenting with multiple alternatives and generating new solutions.

(B) MANAGERIAL THINKING (or conservation) focuses on maintaining and regulating organizational performance. Its output consists of control systems governing production, economic, and financial activities, ensuring that these are carried out in line with strategic decisions, managerial policies, and organizational transformation mechanisms, with the aim of identifying the most efficient paths to reach targeted outcomes (Mella, 2021). Specifically, it:

a) treats strategies as predefined objectives;

b) formulates plans to guide and implement organizational behavior;

c) monitors execution in order to reduce discrepancies between planned and actual performance;

d) thus developing a primarily conservative mode of thinking that is subsequently adaptive;

e) operates through control mechanisms, programming actions to enhance the efficiency matrix by setting goals and defining courses of action that ensure the self-maintenance of the organizational structure;

f) exhibits a predominantly automatic, procedure-based behavior, combined with adaptive responses through planning and control by exception.

As an intelligent cognitive system, using an innovative entrepreneurial thinking, the firm is able to construct actively the reality in which it operates (Weick, 1979; Daft and Weick, 1984; Smirchich and Stubbart, 1985), and to check its path in it, through managerial thinking. Particularly importance is seen in the ability of developing entrepreneurial thinking since it is the basis of innovation and organizational change strategies (Amabile, 1997), but, above all, because it stimulates the differentiation of product and process which represents a crucial determinant of competitive advantage (Andrews & Smith 1996; Im & Workman 2004).

The cognitive and intelligent firm does not fit, therefore, the scope in which it operates, but it creates a different context from the others in relation to its own patterns of knowledge and activates its specific environment, in a typical autopoietic view of structural coupling.

DEFINITION 10/2 – LEARNING ORGANIZATIONS. In a highly dynamic environment, where past experience plays an increasingly limited role, and *exploratory* and *innovative–creative* behavior becomes essential, the organizations with *the highest endogenous teleonomy* will be those that have transformed themselves into a "learning organization", equipping themselves with structures, procedures, and mechanisms that allow them to learn more rapidly, respond promptly, avoid repeating the same mistakes, and create innovation (Garvin, 1993, 2000; Senge, 2006). The permanent organization, being a unified cognitive system, has its own emerging intelligence, which surpasses the "aggregated" intelligence of the individuals who make up its structure (Hejl, 1981); Peter Senge calls this the *learning organization*.

According to Senge, a *learning organization* must be conceived of as an organization where the acquisition of knowledge, individual improvements, and increases in efficiency, though produced by individuals or organizations, must be shared so that they spread throughout the entire network of the organization's micro- processes and increase the performance of the entire organization (organizational learning). Organizations that learn are:

> [. . .] organizations where people continually expand their capacity to create the results they truly desire, where new and expansive patterns of thinking are nurtured, where collective aspiration is set free, and where people are continually learning to see the whole together (Senge 2006, p. 3).

> […] there are striking examples where the intelligence of the team exceeds the intelligence of the individuals in the team, and where teams develop extraordinary capacities for coordinated action (Senge 2006, p. 9).

> The discipline of team learning starts with "dialogue", the capacity of members of a team to suspend assumptions and enter into a genuine "thinking together". […] "The discipline of dialogue also involves learning how to recognize the patterns of interaction in teams that undermine learning" (Senge 2006, p. 10).

12 – The Permanent Organization as a Viable System

The firm is something organic, which intends to survive—and that is why I call it a viable system (Beer 1981, p. 105).

DEFINITION 11 – ORGANIZATIONS AS VIABLE SYSTEMS. The four levels of control systems, which interact to form the organization's "overall control system", allow us to represent organizations in general, and firms in particular, as Viable Systems according to Stafford Beer's cybernetic perspective. In *The Heart of Enterprise* (1979), *Brain of the Firm* (1981), and his other works, the author interprets (defines) organizations as viable systems because, thanks to the overall control system, they behave as units with an observable, unified behavior that tends to maintain their structure alive over time.

A system can be defined as *vital* if it can exist separate from the environment through continual adaptation to this changing environment (control system), even in the presence of disturbances not foreseen at the time the system was designed and realized (viability).

> The viable system is a system that survives. It coheres; it is integral. It is homeostatically balanced both internally and externally, but … has mechanisms and opportunities to grow and to learn, to evolve and to adapt – to become more and more potent in its environment (Beer, 1981, 113).

To maintain the conditions for viability, organizations, as control systems, internally determine the policies and activate the levers and strategies needed to eliminate the negative effects from environmental disturbances during their existence, disturbances which cannot be foreseen at the moment the system is designed and created. In his book Brain of the Firm, Beer provides a definition of viability:

> This book has been wholly about the viable system. There must be criteria of 'independent' viability, even though any system turns out to be embedded in a larger system and is never completely isolated, completely autonomous or completely free (Beer 1981, 226).

> The object is to construct a model of the organization of any viable system. The firm is something organic, which intends to survive—and that is why I call it a viable system free (Beer 1981, p. 226).

To construct this model, Stafford Beer posits the following theorem:

> Recursive System Theorem. In a recursive organizational structure, any viable system contains, and is contained in, a viable system. There is an alternative version of the Theorem as stated in Brain of the Firm, which expressed the same point from the opposite angle: 'if a viable system contains a viable system, then the organizational structure must be recursive' (Beer 1979, p. 118).

In this sense, even the VSM, in line with the autopoietic viewpoint, represents organizations as cognitive, adaptive, long-lasting systems permanently coupled to the environment through systems of communication and exchange.

However, the VSM takes a macro and external perspective, according to which organizations are entities that survive thanks to their cognitive and control structure and are able to communicate with the environment and acquire information needed to define and achieve, through the coordination of the operational units, their institutional objectives. From this point of view, and adopting Varela's analysis, the VSM represents the typical model of a system open to the environment through its own operations and communication activities, though closed regarding the processes of adaptation to environmental dynamics (for details on Beer's model, see: Mella, 2021, Sect. 8.2).

13 – Conclusion

Without even a basic knowledge of the various "types" of systems, it can be difficult to tackle many studies that make extensive use of the systemic approach in its various branches. This study has adopted a neutral "style"—presenting the concepts concisely through a sequence of interconnected definitions, without expressing comments or value judgments about the concepts themselves—in the hope of offering an initial, concise, yet well-documented introduction to modern systemic concepts used in business literature, in all its facets, to make it easier for the reader to integrate their own knowledge system with an understanding of the recent systemic approach.

There are four main *limitations* of the study. *First*: the genesis of organizations and their purposes are not analyzed; only the main interpretative theories of their continued existence are presented. *Second*: relationships between organizations are not taken into consideration; in fact, multiple organizations of the same or different types may interact, in cooperative or competitive forms, often behaving like *combinatory systems* that generate significant emergent effects (Mella, 2025). *Third*: the study does not address the *management* aspect of organizations, many of which exhibit goal-oriented behaviors *directed* by internal bodies. *Fourth*: this brief study does not examine the ways in which organizations, to endure over time, connect with the environment through various types of inputs and outputs, taking external constraints into account.

Having deliberately only briefly mentioned Control Systems Theory (Mella, 2021), Systems Thinking (2012) (in the version proposed by Peter Senge, 2006) and the Theory of Combinatory Systems (Mella, 2025), this contribution certainly does not exhaust the topic of applying systemic notions in the business field. I hope, however, that it may serve as a basis for a future examination of other systemic models of organizations and their processes.

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