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Big Government and Global Governance:
Managing Complexity for the New Society

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Abstract

The paper offers an innovative and original proposal as a solution to the problem of multiscale ontological uncertainty management of the complex interaction between big government and global governance. The reason for this effort can be linked to the postulate that society is an arbitrary complex multiscale system of purposive actors experiencing continuous change. Society is an integrated living organism, not merely an assembly of machinery. Current problems are multiscale-order deficiencies, which cannot be fixed by the traditional hierarchical approach alone or by doing what we do better or more intensely, but rather by changing the way we act. This paper makes use of several past guidelines, from McCulloch, Wiener, Conant, Ashby and von Foerster to Bateson, Beer and Rosen's concept of a non-trivial system to arrive at an Anticipatory Learning System (ALS) for managing unexpected perturbations by an antifragility approach, as defined by Taleb. This ALS component can be defined effectively by Computational Information Conservation Theory (CICT), as presented by Fiorini in 2013. In order to achieve an antifragility behavior, the next generation system for global application needs a new fundamental component, which is able to face the problem of multiscale ontological uncertainty management. This way homeostatic operating equilibria can emerge out of a self-organizing landscape of self-structuring attractor points. This paper presents a relevant contribution towards a new post-Bertalanffy Extended Theory of Systems. Due to its intrinsic self-scaling properties, this systems approach can be applied at any system scale: from single quantum system application development to full system governance strategic assessment policies and beyond.

1. Introduction

Paradoxically, as economic diversification and cultural evolution progress, a big government approach would increasingly fail to lead to good decisions, which is unfortunate. Quite often, from an individual perspective, external events seem to be an entirely random series of happenings. But looked at over a long period of time, and tracking the branching changes in the planet that follow from it, all the chaos does produce a form of identifiable order. Patterns appear out of the chaos. And this, in its essence, is chaos theory: finding order in chaos (Wheatley, 2008). Chaos theory falls into that category of scientific ideas that few actually understand due to its expansive, epic-sounding principles and thoughts, but which many have heard of. Inherent to the theory is the idea that extremely small changes produce enormous effects, but ones that can only be described fully in retrospect. In social systems, any signal is actually small, weak, never strong. Weak signals are "the real foundation of the whole society." (Ansoff, 1975; Poli, 2013) Accurate prediction is somewhat impossible and it is known that the occurrence of extreme events cannot be predicted from past history (Taleb, 2015).

"Our decisions are heavily affected by our cultural heritage."

In recent years, in many areas of science and practices associated with social systems, economics, psychology, biology, biomedical engineering, there is a growing understanding that we should also take into account the effects of anticipation (accounting for the effects of future states of the system because of changes in the present moment of time). Therefore, the emergence of uncertainty as the consequence of anticipation, as well as the appearance of a variety of scenarios in the behavior of social systems have to be taken into account (Dubois, 1998; Poli, 2010; Miller, Poli & Rossel, 2013). Formalization of the concept of anticipation has also been the subject of many papers, especially since the time of Robert Rosen's publications (b.1934–d.1998), who considered the fundamental modeling relationship of the system-model-environment (Rosen, 1985). Essentially the mapping relationship points to the process we carry out when we "do science" and exposes this process as one in which there cannot be a biggest model of the world, but only snap-shots thereof.

Anticipation invariably entails complexity in the psychology of the individual self-system; its role in society is largely described as human perspective. By perspective, we mean human subjectivity. Human subjectivity is shaped by the evolution of identities, values, and expectations. It is the self-system guided by perspective that functions in the process of social interaction in the social process of the human community (Nagan, 2015). Actions not yet carried out or supposed are moved to the past. Anterior future generates a proactive ability associated to an increment of problem solving: to describe a future event, one has to "see it as if it had happened". It is a structuralized thought and therefore leads to action for the execution which one prepares himself for. The simple future seems to lack the planning activity, the anterior future allows one to think of an action as if it was already done (Weich, 1979; Tessarolo, 2007).

Every experience realized by mankind has always provoked further future expectations, to the point that past experience and expectation for the future have progressively separated and expressed through the concept of "progress". The experience of technical progress implies that it is not possible to foresee when, where and how much rapidly something new will be invented or not (Koselleck, 2009). An innovator is a subject who is not afraid of abandoning tradition, and some of his interpretations initially intended as "deviations from the system", as "errors", are nothing but a "displacement of the system" (Tynianov, 1968).

Since the pioneering application of "Cybersyn" to the Chilean economy in the early 1970s (Espejo, 2014) to the recent revisiting of The Viable System Model (VSM), developed by the British operational research and management theorist Stafford Beer (b.1926–d.2002) (Beer, 1972), there has always been a need to understand how complexity is managed in viable organizations (Espejo & Harnden, 1989). Today, environmental conditions are quite different from the 1970s and they are continuously changing at an increasing rate. While the processing power doubles every 1.8 years and the amount of data doubles every 1.2 years, the complexity of networked systems is growing even faster. Both at macro and micro levels decision-making is getting difficult. Almost all decisions are taken under a great risk or uncertainty. There is only one truth; our decisions are heavily affected by our cultural heritage. (EYCH, 2018). Cultural heritage is the fabric of our lives and societies. It surrounds us in the buildings of our towns and cities; our landscapes, natural sites, monuments and archaeological sites. It is not only made up of literature, art and objects but also by the crafts we learn, the stories we tell, the food we eat, the songs we sing, the films we watch, the thoughts we articulate. The success or failure of our actions is largely determined by the decisions we take. While history tends to judge these in terms of their outcomes, a close examination of the reasoning and processes that lead to those decisions can be salutary. Although there is no common definition of "culture", it may be defined as "the unique combination of expectations, written and unwritten rules, and social norms that dictates the everyday actions and behaviours of people." (Cepni, 2015) In an ideal democracy holistic governance requires the co-production of values between policy-makers and citizens to make visible political and expert guidance and people's interests and concerns. Transparency of communications between citizens and policy-makers is far more important than making information available: it is building up effective organisational systems.

In other words, attempts to optimize classic hierarchical systems in the traditional top-down way will be less and less effective, and cannot be done in real time (Fiorini, 2016a). In fact, current human-made applications and systems can be quite fragile to unexpected perturbation because Statistics themselves can fool you, unfortunately (Taleb & Douady, 2015). From this point of view, the current most advanced "intelligent system" is a "deficient system", a fragile system, because its algorithms are still based on statistical intelligence or statistical knowledge only, and they are lacking a fundamental systems component. We need resilient and antifragile applications to be ready for next generation systems. What Nassim Taleb has identified and calls "antifragility" is that category of things that not only gain from chaos but need it in order to survive and flourish. He proposes that things be built in an antifragile manner. An antifragile system is beyond the resilient one. In turn, the resilient is beyond the robust. The robust fails when perturbations are out of its preprogrammed range. The resilient system resists shocks and stays the same; antifragile system gets better and better.

The logical answer is to use distributed (self-) control, i.e. bottom-up self-regulating systems. Advanced Cybernetics (i.e. extended systems theory) and complexity theory tell us that it is actually feasible to create resilient social and economic order by means of self-organization, self-regulation, and self-governance. Complexity science offers a way of going beyond the limits of reductionism, because it understands that much of the world is not machine-like and comprehensible through a cataloguing of its parts; but consists instead mostly organic and holistic systems that are difficult to comprehend by traditional scientific analysis (Lewin, 1993). "Governing the Commons" is a major theoretical contribution to the study of collective action and institutional design. It describes in clear language the problems arising from Common Pool Resource (CPR) management and presents an uncompromising critique of existing approaches (Ostrom, 1990). Nevertheless, to achieve self-organization, self-regulation in a competitive arbitrary-scalable system reference framework, we need application resilience and antifragility at system level first (Fiorini, 2014a).

In fact, decision theory, based on a "fixed universe" or a model of possible outcomes, ignores and minimizes the effect of events that are "outside the model". Deep epistemic limitations reside in some parts of the areas covered in classical decision-making. Unfortunately, the "probabilistic veil" can be quite opaque, and misplaced precision leads to incompleteness, ambiguity and confusion. In fact, as the experiences in the last fifty years have shown, unpredictable changes can be very disorienting at the enterprise level. These major changes, usually discontinuities referred to as fractures in the environment rather than trends, will largely determine the long-term future of organization. They need to be handled as opportunities, and as positively as possible (Taleb, 2015). In a continuously changing operational environment, even if operational parameters cannot be closely pre-defined at the system planning and design level, we need to be able to plan and to design antifragile self-organizing, self-regulating and self-adapting systems quite easily anyway.

"Every good regulator of a system must be a model of that system." (Conant and Ashby, 1971) Therefore, we need a system that is able to manage multiscale ontological uncertainty effectively. We need Anticipatory Learning System (ALS) as a fundamental system component (Fiorini & Santacroce, 2013b). In fact, to behave realistically, system must guarantee both Logical Aperture (to survive and grow) and Logical Closure (to learn and prosper), both fed by environmental "noise" (better compared to what human beings call "noise") (Fiorini, 2014b). For instance, current scientific computational and simulation classic systemic tools and the most sophisticated instrumentation system (developed under the positivist, reductionist paradigm and the "continuum hypothesis", CH for short) are still totally unable to capture and to discriminate the so called "Random Noise" (RN) from any combinatorically optimized encoded message, called "Deterministic Noise" (DN) by Computational Information Conservation Theory (CICT) (Fiorini, 2014a). This is the Information Double-Bind (IDB) dilemma in current science, and nobody likes to talk about it (Fiorini, 2016a).

Ambiguity emphasizes this major IDB problem in current, most advanced research laboratory and instrumentation system, just at the inner core of human knowledge extraction by experimentation in current science (Fiorini, 2016a). How is it that scientists 1.0 (statisticians) are still in business without having worked out a definitive solution to the problem of the logical relationship between experience and knowledge extraction? It is a problem to solve clearly and reliably, before taking any quantum leaps to more competitive and convenient, at first sight, post-human cybernetic approach in science and technology. We need to extend our systemic tools to solve this IDB dilemma first and then achieve real machine intelligence to open a new era of effective, real cognitive machine intelligence (Wang et al., 2016).

To get a stronger solution, even for advanced multiscale biophysical scientific modelling problems like social, quantum cognitive, neuroscience understanding, living organism modelling, etc., we have to look for convenient arbitrary multi-scaling, bottom-up modelling (from discrete to continuum, under the "discreteness hypothesis" (DH for short) approach to start from first, and NOT the other way around (top-down, from continuum to discrete, CH), as conventionally done! The present paper offers an innovative solution to be discussed. It is a relevant contribution towards a new post-Bertalanffy Extended Theory of Systems to show how homeostatic operating equilibria can emerge out of a self-organizing landscape of self-structuring attractor points in a natural way.

2. Social Communication Complexity and Purposive Actors' Propositional Fallacies

Our understanding of society and the theories formulated to explain it are limited by the fracturing of disciplines, the cultural and historical biases of space and time, and the social constructions of the values and beliefs implicit to our world view. In addition, they are circumscribed by the types of thinking we employ to understand social reality. Systems thinking developed during the 20th century to counter the fragmented piecemeal perspectives of discipline-specific, sectoral viewpoints.

Past and current efforts to combine and integrate perspectives from different disciplines were and still are hindered by the absence of a unifying conceptual framework. For instance, the actual division of social science disciplines and sub-disciplines into separate specialized fields reflects a view of social reality as a composite of many independent pieces that can be assembled like the parts of a machine rather than the highly integrated organic reality, which it actually is. The subsequent development of each discipline and sub-discipline silos in its own direction further aggravates this initial division leading to untoward consequences. Silos are good for grain, but not for brain! Forging linkages between phenomena and disciplines through multi-disciplinary and inter-disciplinary approaches is necessary but not sufficient to address the complex integrality of social reality.

Social reality is an integrated indivisible whole, not a mechanical assembly. It cannot be fully comprehended or managed by combining any number of discrete perspectives and policy measures. The whole is greater than the sum of its parts. They all involve the generation and release of human energies, the focusing of those energies into force for specific purposes, the conversion of that force into power and the expression of that power to achieve results. All social progress harnesses the power of resources to convert social potential into accomplishment.

Modern economies are conscious living systems increasingly fueled by human and social resources that are not subject to inherent material limits. Material resources are consumed in the process of utilization. Non-material resources such as information, knowledge, technology, skill and organization multiply in the very process of being utilized. Human capital and social capital grow in quality, utility and value through usage and experience. The argument that subjective factors are too difficult to measure is increasingly challenged by the development of alternative measures and justifies much more serious efforts by mainstream economists to evolve new methods, rather than ignore this essential dimension of reality.

Society is an integrated living organism, not merely an assembly of machinery. More holistic, synthetic, and intuitive forms of understanding are also needed to comprehend underlying causes and remedies to current problems. More integrated conceptual systems and theoretical frameworks are needed that view social phenomena inclusively, comprehensively and integrally. Literature and the other humanities offer important perspectives for overcoming the reductionist tendency of specialized analytic disciplines.

Society is, without any doubt, a complex system and the idea of applying the knowledge from the analysis of physical complex systems in the analysis of societal problems is tempting. Indeed, the notions of nonlinearity, interactions, self-organization, stability and chaos, unpredictability, sensitivity to initial conditions, bifurcation, etc., are phenomena which also characterize social systems.

However, not everything is easy because physical and computational measures of complexity exist in abundance. These can provide a starting point for creating social complexity metrics, but they need to be refined and continuously updated for the simple reason that society is an aggregation of purposive actors. To harness complexity, we must take a generative perspective and see social outcomes as produced by purposive actors responding to personal anticipation, incentives, information, cultural norms, psychological predispositions, etc. In other words, as Robert Rosen said, in his book *Life Itself*, "The Machine Metaphor of Descartes is not just a little bit wrong, it is entirely wrong and must be discarded." (Rosen, 1991) As a matter of fact, purposive actors are centered on their wellbeing dynamic equilibrium or balance that can be affected by life events or challenges continuously. The state of personal wellbeing is stable when subjects have the resources needed to match and manage their life's challenges (Fiorini, De Giacomo & L'Abate, 2016).

One of the fundamental preconditions is to speak in the common language. It is not the problem of cultures only (Leung et al., 2007); it is also a problem of scientific communities (Kagan, 2009; Snow, 1969) and new societal education (UNE, 1997; Jacobs, 2014; Mulder, 2015). For instance, educational curricula in human-computer interaction (HCI) need to be broad and nimble. To address the first requirement, HCI focuses on people and technology to drive human-centered technology innovation. At the same time, students need to develop methods and skills to understand current users, to investigate non-use, and to imagine future users quickly (Churchill, Bowser, & Preece, 2016).

We need an evolving education that is able to let a common language emerge and to explore the socially-construed conception of resources, social potential to discern their source, nature, boundaries, limits and the means to more consciously and effectively harness them to promote human welfare and wellbeing (Fiorini, De Giacomo & L'Abate, 2016). The untapped creative potential of material, social and human resources is a constituent of the creative sink we call Society. Society is the source of all human accomplishment, individual and collective, all the knowledge, values, skills, technological, social, organizational, institutional, psychological and cultural instruments devised by human beings to further their development.

At a wider level, we, the children of the Anthropocene Era, are just moving beyond the "Information Age" (Visser, 1993) to the "Conscious-Technology Age" (Glenn, 2015). The term "Anthropocene Era" was widely popularized in 2000 by atmospheric chemist Paul J. Crutzen who regards the influence of human behavior on Earth's atmosphere in recent centuries as so significant as to constitute a new geological epoch (Dawson, 2016). In fact, Anthropogenic activity is now recognised as having profoundly and permanently altered the Earth system, suggesting we have entered a human-dominated geological epoch, the "Anthropocene" effectively (Turney et al., 2018).

In 1995, American futurist Hazel Henderson, in her book "Paradigms in Progress," states her position unequivocally: "The Information Age is no longer an adequate image for the present, let alone a guide to the future. It still focuses on hardware technologies, mass production and economic models of efficiency and competition, and is more an extension of industrial ideas and methods than a new stage in human development." With her usual combination of hard data and clear-cut reasoning, Henderson showed that war hurts people, damages ecosystem services, and impairs the normal operation of economies more than any other violent force of society or nature. Could war be waged between nations or factions without support of businesses that reap benefits from it? Could the contributions of businesspeople to the building of the ethical girder stop the production of arms and get mass media to emphasize loving and tender communications among humans, and between humans and nature, rather than violence? (Henderson, 1995). Later, in 2007, she announced the mature presence of the green economy. Mainstream media and big business interests have sidelined its emergence and evolution to preserve the status quo (Henderson, 2007).

The Conscious-Technology Age will force us to confront fundamental questions about life as a new kind of civilization emerges from the convergence of two mega-trends. First, humans will be part of symbiotic systems, as our individuality and biology become integrated with technology in a symbiotic relationship. Second, our built environment will incorporate more artificial intelligence and intelligent systems. We are entering the 4thIndustrial Revolution (Fourth Industrial Revolution, FIR) and the impact is going to be pervasive and of greater magnitude compared to the previous industrial revolutions. Industry 4.0 is not a prescriptive standard that any manufacturer or component supplier has to follow to the letter, yet. However, it is undoubtedly a trend and range of practices embracing automation, smart systems, IoT, cloud computing, AI and deep learning. Governance could be vastly improved by collective intelligence systems; it could become easier to prevent and detect crime; needs and resources could be matched more efficiently; opportunities for self-actualization could abound; and so on. It would be wise to think through the possibilities today and shape our evolution to create the future civilization we desire.

The incoming changes, approaching at an accelerating speed, will be affecting everything and everybody and blurring the lines between the physical, digital, and biological spheres; they will affect the bio-psycho-social dimensions, our narratives and even what it means to be human. If we are not farsighted and do not plan effectively, the results could be very problematic for all life forms on Earth. If we manage the 4th Industrial Revolution with the same blindness and forms of denial with which we managed the previous industrial revolutions, the negative effects will be exponential (Zucconi, 2016). At the social level, inequality and unemployment destroy opportunity freedom. Radical inequality significantly undermines opportunity freedoms and capacity freedoms and consequently radically undermines human capital as a foundation of community prosperity (Nagan, 2016).

Even in mere terminology, avoiding or minimizing representation of uncertainty and ambiguities is mandatory to achieve and maintain high quality result and service. The proper use of multidimensional conceptual clarity is fundamental to create and boost outstanding performance. As an example, for high quality clinical and telepractice results in healthcare informatics research and technology, understanding the difference between "well-being" and "wellbeing" is mandatory (Fiorini, De Giacomo & L'Abate, 2016). In order to move up in the value chain (or Lancasterian evolution tree, or wellbeing of society), it is also important to build up the knowledge corpus domestically and with domestic resources first (Kitt, 2016).

When uncertainty and ambiguities cannot be avoided, then reliable uncertainty management systems are needed. There are surprising similarities in many fields of human activities and much can be learned from these. For instance, Puu discussed bifurcations that are likely to govern the evolution of culture and technology. More specifically, by defining culture as art plus science, he discusses the evolution of social and material products (Puu, 2015).

Another fundamental problem is causality because the observations always reveal superficial reasons only; they cannot reveal deep, concealed reasons (Fiorini, 2016b; Wang et al., 2016). Forcing societies to fit in a box without understanding the reasons in depth may lead to serious consequences like we witness in many world affairs. Interdisciplinarity and transdisciplinarity are modes through which the society together with scientists and scholars must navigate (De Giacomo & Fiorini, 2018; Nicolescu, 2008).

As a matter of fact, traditional ordinary linguistic entities and structures are not real objects, as they are only subjective symbolic representations. Therefore, they need an appropriate, reliable structural conditioning first to become formal shareable descriptions and to obtain their semantic formalization and endorsement at the social communication level. Restrictions are pervasive in human cognition. In one form or another, restrictions underlie much of the exchange of information which takes place in daily conversations between humans. Restrictions underlie the remarkable human ability to reason and to make rational decisions in an environment of imprecision, uncertainty and incompleteness of information. Such environments are the norm in the real world. There are many applications in which the semantics of information play an important role. A few such applications are: social communication, machine translation, summarization, search and decision-making under uncertainty. Much of what is called “world knowledge” (WK) consists of restrictions. WK is the knowledge about the world which humans live in (Zadeh, 2004). In fact, we can formalize semantics as a relationship between shareable well-defined structures to arrive at the fundamental difference in the ontological status of structured symbols and the real object represented by these symbols.

In every discourse, whether of the mind conversing with its own thoughts, or of the individual in his intercourse with others, there is an assumed or expressed limit within which the subjects of its operation are confined. The most unfettered discourse is that in which the words we use are understood in the widest possible implication, and for them the limits of discourse are co-extensive with those of the universe itself. But more usually we confine ourselves to a less spacious field. Sometimes, by ‘discoursing’ of human beings we imply (without expressing the limitation) that it is only of human beings under certain circumstances and conditions that we speak, as of civilized men, or of human beings in the vigor of life, or of human beings under some other condition or relation. Now, whatever may be the extent of the field within which all the objects of our discourse are found, that field may properly be termed the “universe of discourse” (Boole, 1854/2003). This concept, probably created by the Irish mathematician, educator, philosopher and logician George Boole (b.1815–d.1864) in 1847, played a crucial role in his philosophy of logic, especially in his stunning principle of “wholistic reference” (Corcoran, 1995; 2004).

The term “universe of discourse” generally refers to the collection of symbolic objects being managed and discussed in a specific discourse. In current model-theoretical semantics, a universe of discourse is the set of symbolic entities that a model is based on. Furthermore, this universe of discourse is in the strictest sense the ultimate subject of the discourse and human ability to use logic, to integrate the evidence of our senses in a non-contradictory way, is part of our rational faculty, the very faculty that makes us human. Obviously, we also have the capacity to be illogical, but that is because our rational faculty also entails volition, the power to choose to think or not to think.

According to Swiss clinical psychologist Jean Piaget (b.1896–d.1980), human adults normally know how to use properly classical propositional logic. Piaget also held that the integration of algebraic composition and relational ordering in formal logic is realized via the mathematical Klein group structure (Inhelder & Piaget, 1955.) In the last fifty years, many experiments conducted by psychologists on reasoning have often shown most adults commit logical fallacies in propositional inferences. These experimental psychologists have so concluded, relying on many empirical evidences, that Piaget's claim about adults' competence in propositional logic was wrong and much too rationalist. But, doing so, they forgot Piaget's rigorous and important analysis of the Klein group structure at work in logical competence. In other words, according to experimental psychologists, Piaget was overestimating the logical capacities of average human adults in the use of classical propositional logical connectives. As a matter of fact, people tend to treat conditionals as equivalences and inclusive disjunctions as being exclusive (Robert & Brisson, 2016).

Figure 1. Piaget-Klein Group Cayley Table. The four fundamental transformations of predicative competence: identical transformation (I), inverse transformation (N), reciprocal transformation (R), and finally, the dual transformation (D) (see text)

x	**I**	**N**	**R**	**D**
I	I	N	R	D
N	N	I	D	R
R	R	D	I	N
D	D	R	N	I

Nevertheless, the Klein group structure Piaget used can be reused to help us understand better what happens in spontaneous human reasoning and in the production of fallacies. In fact, in mathematics, the Klein four-group or "*Vierergruppe*", named by German mathematician Felix Klein (b.1849– d.1925) in 1884, is a group of four transformations with four elements. The Klein four-group is the smallest non-cyclic group, and every non-cyclic group of order 4 is isomorphic to the Klein four-group. The cyclic group of order 4 and the Klein four-group are therefore, up to isomorphism, the only groups of order 4. Both are abelian groups in mathematics. Piaget applied the Klein four-group to binary connectives, so that a given connective is associated first with itself (in an identical (I) transformation) and then with its algebraic complement (its inverse (N) transformation), also with its order opposite (its reciprocal (R) transformation) and finally, with the combination of its N and R transformations (that Piaget calls its "correlative" or C transformation) (Inhelder & Piaget, Ch.17). This correlative corresponds to what logicians usually call the "dual" (D) transformation (see Figure 1) (Robert & Brisson, 2016).

The Klein group structure generates squares of opposition (SOO), and an important component of human rationality resides in the diagram of the SOO, as formal articulations of logical dependence between connectives (Fiorini, 2018). The origin of the SOO can be traced back to Aristotle, who made the distinction between two oppositions: contradiction and contrariety. But Aristotle did not draw any diagram. This was done several centuries later by Apuleius and Boethius in the second and sixth centuries. SOO are considered as important basic components of logical competence and human predicative rationality (Beziau & Payette, 2012). Treating conveniently neutral elements (I), algebraic complements (N) and order reciprocals (R) in an integrated structure, with a valid treatment of duals (D), would guarantee people to make logically valid classical inferences on propositions to achieve conceptual clarity (Fiorini, 2018b).

But the formal rationality provided by the SOO is not spontaneous and therefore, should not be easy to learn for adults. This is the main reason why we need reliable and effective training tools to achieve full propositional logic proficiency in decision making, like the elementary pragmatic model (EPM) (De Giacomo & Fiorini, 2018). In fact, from an abstract point of view, EPM can be even seen as the logical description of the fundamental interactions between two Klein groups. In other words, EPM can model all the elementary interactions between two rational, interacting subjects. Currently, the notion of reasoning or conscious reason may be interpreted in terms of the reasoning process itself being explicitly modeled by the reasoning agent (Gaines, 2010). In this way, we arrive at the core understanding of "the difference that makes the difference." (Bateson, 1972, pp.457-9)

Metaphors encompass often our everyday communication and can also be used in explaining the behavior of complex social systems. Such an approach, developed initially by English anthropologist and social scientist Gregory Bateson is advocated by De Giacomo & Fiorini (2018), and Wheatley (2008) for management and leadership. They do not enter into the technical details of chaos theory and complexity in terms of physical systems but recommend using these ideas convincingly in the management of social systems and also for educational purposes.

As a further, more interesting example, the Piaget-Klein group structure can be even interpreted as the transformation mapping of human perception and representation of our outer and inner universe representation, where the encoding process is carried out by human affectors (our biological sensors) and the decoding process is done by human effectors (our biological actuators). In this way, the single observer encoding and decoding relationships of the classic Rosen mapping can be computationally formalized at the operative level (De Giacomo & Fiorini, 2018; Fiorini, 2018b).

3. Communication and the Reflective Elementary Dichotomy Structuring Process

Mankind's best conceivable worldview is at most a representation, a partial picture of the real world, an interpretation centered on man. We inevitably see the universe from a human point of view and communicate in terms shaped by the exigencies of human life in a natural uncertain environment. What is difficult is processing the highly conditioned sensory information that comes in through the lens of an eye, through the eardrum, or through the full skin. In fact, at each instant, a human being receives an enormous volume of data, and we have a finite number of brain cells to manage all the data we receive quickly enough.

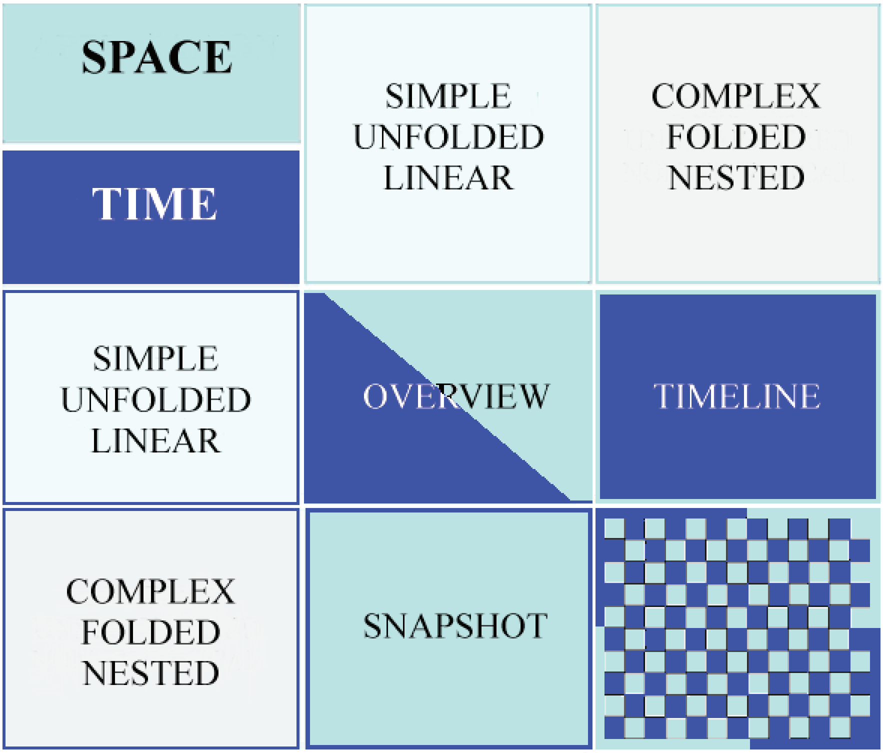
According to traditional theories, brain researchers estimate that the human mind takes in 11 million pieces (tokens) of information per second through our five senses but is able to be consciously aware of only 40 of them (Koch et al, 2006; Wilson, 2004; Zimmermann, 1986). So, our neurointerfaces and brain have to filter to the extreme. To better clarify the computational paradigm, we can refer the following principle: "Animals and humans use their finite brains to comprehend and adapt to an infinitely complex environment." (Freeman & Kozma, 2009) We are constantly reconstructing the world's essential and superficial characteristics. This is the outcome of the ongoing evolution of our relationships in a world full of surprises and challenges (Espejo, 2011) related to deeper characteristics (Fiorini, 2018a).

Spacetime (ST) invariant physical quantities can be related to the variables employed by a specific interacting observer to get an interpretation of the world within which a human being is immersed. In fact, original "spacetime" (a transdisciplinary concept of classical operative interpretations) is split into two separate additive subcomponents, namely "space" and "time." In that forced passage original information is lost or dissipated to an unaware interactor (Fiorini, 2015a).

This forced operational splitting may represent an advantage by a formal (rational) representation point of view (i.e., ease of representation and understanding), but its major drawback is an original information precision loss, if the observer is unaware of or unable to compensate for it partially, not taking into consideration the folding and unfolding properties offered by CICT "OpeRational" representation (Fiorini & Laguteta, 2013a). For instance, according to CICT, the full information content of any symbolic representation emerges out of the capturing of two fundamental coupled components: the linear component (unfolded) and the nonlinear one (folded). Referring to the transdisciplinary concept (Nicolescu, 1996), we see that for full information conservation, any transdisciplinary concept emerges out of two pair of fundamental coupled parts.

From a common language perspective, taking into consideration the folding and unfolding properties of CICT "OpeRational" representations for the Space-Time Split (STS) (Fiorini, 2015a), one can conceive a better operative understanding of the usual terms, with the added possibility of information conservation as shown in "The Four Quadrants of The Space-Time Split" (Figure 2) through a narrative point of view. Here, the term "Timeline" (first quadrant, top right) is considered to be the combination of a major linear time representation framed by folded minor space representation. The term "Overview" (second quadrant, top left) is interpreted as the combined representation of major linear space and major linear time representations, with minor complementary folded time and space components. The term "Snapshot" (third quadrant, bottom left) can be assumed as the combination of a major linear space representation framed by the minor folded time representation. The fourth quadrant (bottom right) represents the combination of major folded space and time components, framed by the combination of minor linear space and time components. It can be interpreted as a simple (bidimensional) but realistic representation of the usual information experienced by a living organism.

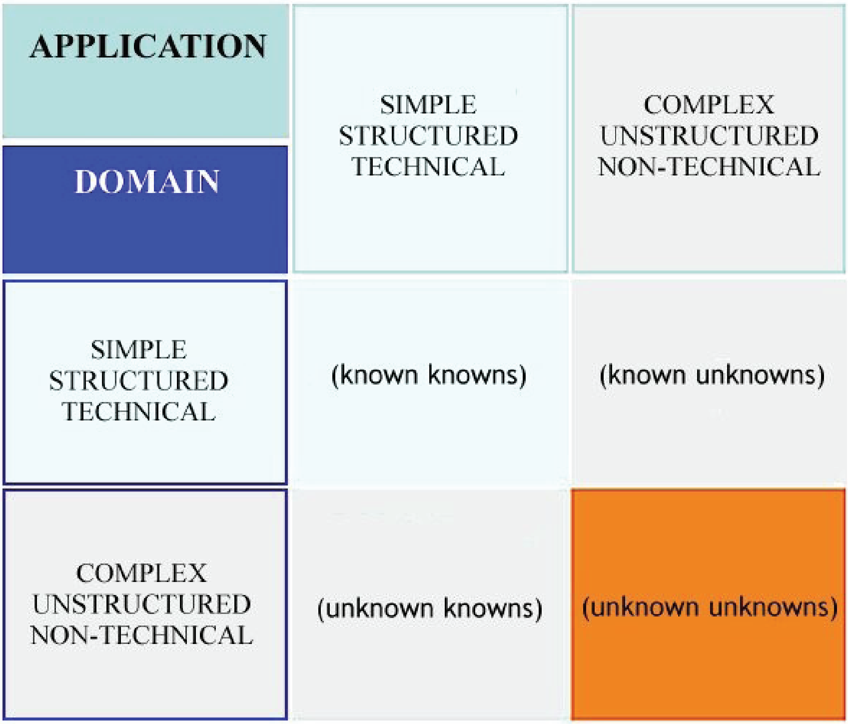
Figure 2. The Four Quadrants of The Space-Time Split (STS)



In other words, for CICT to capture the full information content of any elementary symbolic representation, it is necessary to conceive of a "quadratic support space" at least. Of course, we can apply our dichotomizing process in a recursive way to achieve any precision we like. As an operative example, we can use previous understanding for the representation of human experience by a narrative point of view, to be used effectively in human knowledge structuring and computer science modeling and simulation. We can start to divide human experience into two interacting concepts or parts, “Application” and “Domain,” in the sense that experience is always gained when an Application is developed to act within a Domain, and a Domain is always investigated by a developed Application. In terms of ultimate truth a dichotomy of this sort has little meaning but it is quite legitimate when one is operating within the classic mode used to discover or to create a world of “immediate appearance” by narration. In turn, both Domain and Application can be thought of being in “simple mode” (SM, linearly structured, technical, unfolded, etc.) or in “complex mode” (CM, non-linearly structured or unstructured, non-technical, folded, etc.) description, as defined by Fiorini (1994).

The SM Application or Domain represents the world primarily in terms of “immediate appearance” (superficial reasons), whereas a CM Application or Domain sees it primarily as an “underlying process” in itself (deep, concealed reasons). CM is primarily inspirational, imaginative, creative, intuitive: feeling rather than facts predominate initially. “Art” when it is opposed to “Science 1.0” is “feeling transmission” rather than “data transmission”. It does not proceed by data, reason or by laws. It proceeds by feeling, intuition and aesthetic resonance. The SM, by contrast, proceeds by data, logic, reason and by laws, which are themselves underlying forms of rational thought and behavior. Therefore, we can assume, for now, to talk about human experience by referring to SM and CM, Application and Domain, according to the Four-Quadrant Scheme (FQS) of Figure 3.

Figure 3. Four-Quadrant Scheme (FQS) for Application and Domain



SM is straightforward, unadorned, unemotional, analytic, economical and carefully proportioned. Its purpose is not to inspire emotionally, but to bring order out of chaos and make the "unknowns known." It is not aesthetically free and natural style. It is "aesthetically restrained." Everything is under control. Its value is measured in terms of the skill with which this control is maintained. From the CM point of view the SM often appears predictable, dull, awkward, limited and ugly. Everything is in terms of pieces and parts and components and relationships. Nothing is figured out until it is run through the computer a dozen times. Everything has got to be measured and proved. Within SM, however, CM has some appearances of its own; irrational, erratic, unpredictable, untrustworthy, sometime frivolous, etc. By now these battle lines should sound a little familiar. This is the source of the current trouble between these two cultures.

"One of the most highly developed skills in contemporary Western civilization is dissection: the split-up of problems into their smallest possible components. "We are good at it. So good that we often forget to put the pieces back together again"."

Human beings and researchers tend to think and feel exclusively in one mode or the other and in so doing tend to misunderstand and underestimate what the other mode is all about. But no one is willing to give up the truth as he/she sees it, and as far as we know, quite a few individuals now living have been attempting a real reconciliation of these truths or modes, which is mandatory for the new "Science 2.0" worldview. There is no social, formal shared point at which these visions of reality are unified at present. But if you can keep hold of the most obvious observation about SM Application or Domain, some other things can be noticed that do not at first appear and which can help to understand a convenient unification point.

The first is that in traditional Science 1.0 approach, apart from recent disciplines' risk analysis and computer security areas, any interacting observer is missing. Any classical SM Application or Domain description does not take into consideration the observer. Even an operator is a kind of personalityless robot whose performance of a function on a device is completely mechanical. There are no real subjects in this description. The only objects that exist are independent of any observer.

The second is that to standard Science 1.0, dichotomy is a simple cut-and-split process. As a matter of fact, there is an arbitrary knife moving here: an intellectual scalpel so swift and so sharp you sometimes do not even see it moving. You get the illusion that everything is there and that anything is being named as it exists. But they can be named and organized quite differently depending on how the knife moves. It is important to see this knife for what it is and not to be fooled into thinking that anything is the way it is just because the knife happened to cut it up that way. It is important to concentrate on the knife. As a matter of fact, one of the most highly developed skills in contemporary Western civilization is dissection: the split-up of problems into their smallest possible components. "We are good at it. So good that we often forget to put the pieces back together again" (Toffler, 1984).

The third is that the words good and bad and all their synonyms are completely absent. No value judgments have been expressed anywhere, only facts.

"Traditional mechanistic, reductionist, materialistic, compartmentalized social theory is inadequate to deal with the multi-dimensional complexity of social events and outcomes."

The fourth is that anything under CM is almost impossible to understand directly without experiencing it, unless you already know how it works. The immediate surface impressions that are essential for primary understanding are gone. Nevertheless, the masterful ability to use this knife effectively can result in coming up with creative solutions for the SM and CM split (De Giacomo & Fiorini, 2017). For now, we have to be aware that even the special use of the terms SM and CM is an example of this knife-manship.

4. Ontological Uncertainty Management (OUM) Model

According to the neurophysiological findings by Joseph LeDoux (1998; 2002; 2015), we focus on ontological uncertainty (Lane & Maxfield, 2005) as an emergent phenomenon out of a complex system. Then, our dynamic ontological perspective can be thought of as an emergent, natural operating point out of, at least, a dichotomy of two fundamental coupled irreducible and complementary ideal asymptotic concepts:

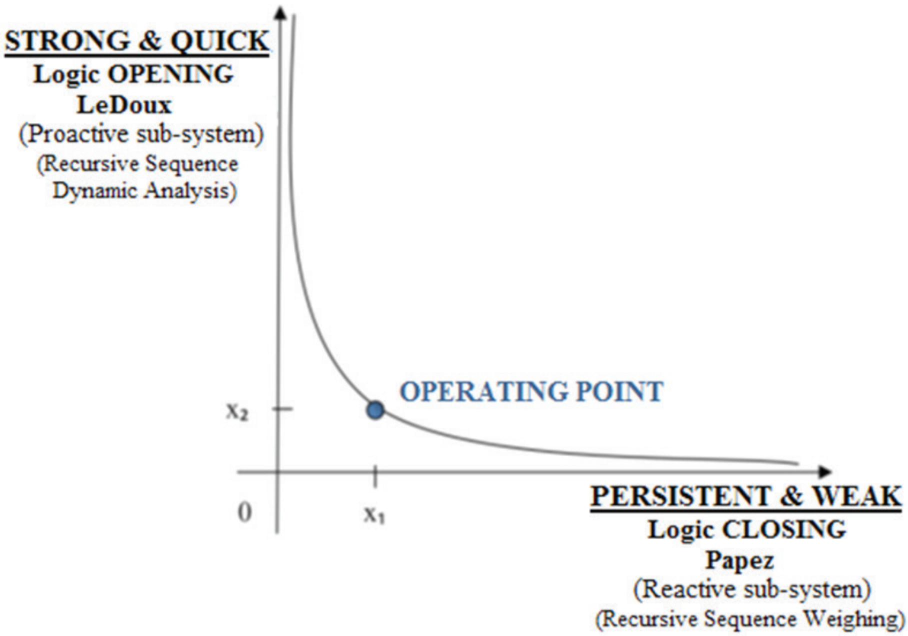
a. reliable predictability, and
b. reliable unpredictability.

From the Top-Down (TD) management perspective, the reliable predictability concept can be referred to as traditional system reactive approach (operative level, lag subsystem, closed logic, to learn and prosper) and operative management techniques. The reliable unpredictability concept can be associated to system proactive approach (strategic level, lead subsystem, open logic, to survive and grow) and strategic management techniques.

As discussed previously, to achieve our final goal, the overall system must be provided with a smart sensing interface, which allows reliable real-time interaction with its environment. To behave realistically, the system must guarantee both Logical Aperture (to survive and grow) and Logical Closure (to learn and prosper), both fed by environmental "noise" (better compared to what human beings call "noise") (Fiorini, 2014b).

So, according to previous considerations, at the brain level, it is possible to refer to the LeDoux circuit ("low road", Logical Aperture) for emotional behavior (i.e. fear, emotional intelligence, etc.) and to the Papez circuit ("high road", Logical Closure) for structured behavior (i.e. rational thinking, knowledge extraction, etc., as per Figure 4. Emotional Intelligence (EI) and Emotional Creativity (EC) (Goleman, 1995) coexist with Rational Thinking in human mind, sharing the same input environment information (Gunderson & Holling, 2002). Then, an operating point can emerge as a transdisciplinary reality level from the interaction of two complementary irreducible, asymptotic ideally coupled subsystems with their common environment.

Figure 4. Operating Point can emerge as a new Transdisciplinary Reality Level (TRL), based on Two Complementary Irreducible Management Subsystems interacting with their common environment (Gunderson and Holling, 2002).



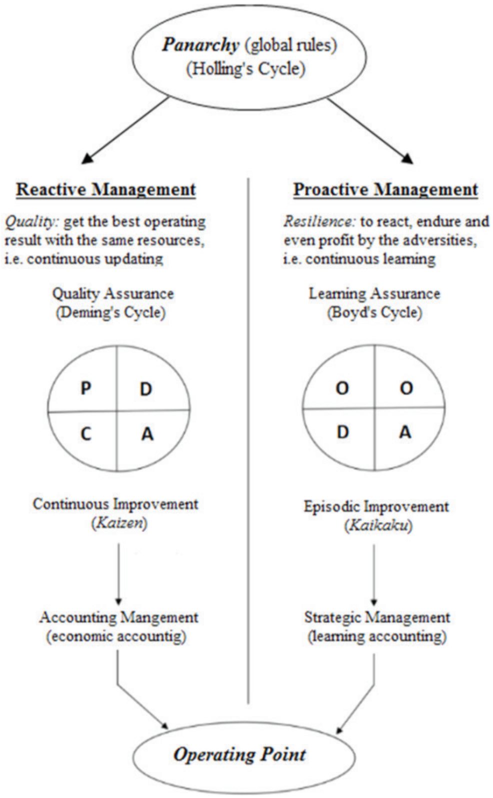
The major added value of present work is provided by the author's fresh approach to Ontological Uncertainty Management (OUM) modelling and by the new idea of system articulated interaction, defined by inner and outer system information resonance and aggregation. It can allow both quick and raw system response (to survive and grow) and slow and accurate information unfolding for future response strategic organization (to learn and prosper) by coherently formatted operating points (Fiorini, 2015b). Thus, new advanced systemic information application can successfully and reliably manage a higher system complexity than at present, with a minimum of design constraints specification and less system final operative environment knowledge at the design level.

In fact, a natural living organism does perturb its environment, but ordinarily only up to the level it is perturbed in turn by its own environment both to survive and grow, and no more (Gunderson & Holling, 2002.) Due to its intrinsic self-scaling relativity properties, this systems approach can be applied at any system scale: from single quantum system application development to full system governance strategic assessment policies and beyond. It is possible to use the same nonlinear logic approach to guess a convenient basic architecture for Anticipatory Learning System (ALS) (Fiorini & Santacroce, 2013b) to get a realistic modeling of natural behavior to be used in High Reliable Organization (HRO) application development.

As an example, the author has shown that traditional data processing and pattern recognition in a cognitive task application (spoken sentence comprehension), using traditional electroencephalography (EEG) data and ERP preprocessing, can offer a shallow interpretation of experimental data. A deeper interpretation can be reached by the CICT approach and VEDA analysis tool. In this case brainstem function can be much better exploited for system modelling. In fact, the overall response result emerges out of the coherent composition of five different subsystem outputs, which start to coherently cooperate with one another immediately upon input stimuli onset (Fiorini, 2015b). CICT coherent representation precision then leads to more experimental information clarity and conservation.

As a matter of fact, the basic operational concepts discussed in previous sections can be conveniently and successfully extended to many other advanced business and HRO application areas, with no performance or economic penalty, to develop a more competitive application.

Figure 5. Final Architecture for Effective Systemic Global Governance Framework



For instance, at a higher level of abstraction, environmental noise input information to be aggregated into system internal status information can provide a structured homeostatic synthetic operating point as a reference for further inquiry. Then, System Interaction by internal and external information aggregation can allow both quick and raw response (Open Logic response, to survive and grow) and slow and accurate information for future response strategic organization (Closed Logic response, to learn to adapt and prosper) by coherently formatted operating point information (Fiorini, 2016a).

"Consciousness and choice are primary determinants of future outcomes."

To arrive at a general framework, for closed logic Reactive Management system, it is possible to choose from different documented operational alternatives offered by literature, like Deming's PDCA Cycle (Ohno, 2012), Discovery-Driven Planning (McGrath, and MacMillan, 1995; 2009), etc., while for open logic Proactive Management system, from Boyd OODA Cycle (1987) (Osinga, 2006), Theory-Focused Planning (Govindarajan and Trimble, 2004), and many others. As a simple example, PDCA's cycle (Reactive Management) and OODA's cycle (Proactive Management) can be selected to represent two corresponding complementary irreducible sub-systems for advanced integrated operative-strategic management. Then, our final, general operative reference architecture, for Effective Systemic Global Governance, is given in Figure 5.

5. Summary

Traditional mechanistic, reductionist, materialistic, compartmentalized social theory is inadequate to deal with the multi-dimensional complexity of social events and outcomes (Fiorini, 2017). Social science needs to unpack the significant characteristics that differentiate physical, biological and social systems. An effective science of society would necessarily have to transcend disciplinary boundaries to identify principles and processes fundamental to all fields and forms of social activity, change, development and evolution. Consciousness and choice are primary determinants of future outcomes (Baumeister, Maranges & Sjåstad, 2018). Among them, perception of the present and anticipation of the future are powerful drivers (Jacobs, 2015).

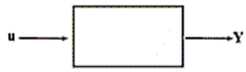
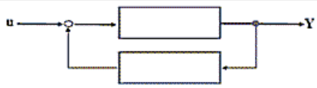
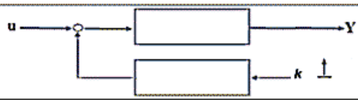
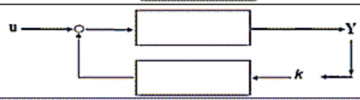
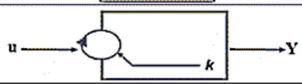
In order to provide reliable anticipatory knowledge, a system must produce predictions ahead of the predicted phenomena, to be verified by a reality level comparison, to be validated and accepted, to be remembered as learned reliable predictions. This validation cycle (emulation) allows system tuning and adaptation to its environment automatically and continuously. Therefore, current traditional formal systems are unable to capture enough information to model natural systems realistically and to describe their emergent properties effectively.

The following proposal of Five Order Cybernetics Framework (Figure 6) acknowledges just the complex system's emergent properties. Emergence entails a greater complexity that reduces traditional knowability and predictability. It also implies that a system will "immerge" into its environment, of which it is a part. Immergence means "submergence" or "disappearance in, or as- if- in, a liquid". If the system is determined by its contact with its context, then the reverse also applies.

The proposed "fourth order cybernetics" (Figure 6) deals with the system and its context simultaneously (multiscale interactivity), where relational complexity and system anticipatory ability are singular hallmarks of life (Rosen, 1985). The basic principles involved are already intuitively implied in First, Second and Third Order Cybernetics, but now they are shown as unfolded and more explicitly. So, in this way, it is possible to achieve an ideal cybernetic concept of evolutionary categorization by the proposed five orders (1 + 4) framework, to offer a new reliable conceptualization for Social, Biomedical and general complex multiscale system applications:

1. Zero Order Cybernetics (Clausius): ideal, closed system, totally isolated open-loop system.
2. First Order Cybernetics (Wiener): "Self-steering" is assumed to be isolated from the act of observation and negative feedback functions as part of a mechanical process to maintain homeostasis.
3. Second Order Cybernetics (von Foerster): the process of "self-steering" is now understood to be affected by observer/s, but the related mathematical modeling is insufficiently complex to encourage new values to emerge. Nevertheless, it is understood that Positive and Negative Feedback can lead to morphogenesis intuitively.
4. Third Order Cybernetics (Bateson, Beer, Ashby): the process is understood as an interaction that can affect/be affected by many observers, but it does not address what this means for the "social response-ability" of the single participant observer. Articulated values emerge.
5. Fourth Order Cybernetics (Rosen): multiple realities emerge by the freedom of choice of the creative observer that determines the outcome for both the system and the observer. This puts demands on the self-awareness of the observer, and response-ability for/in action.

Figure 6. Five Order Cybernetics Framework: Main Graphical Components

BIOMEDICAL CYBERNETIC ORDER	INTERACTION STYLE	GRAPHIC SYMBOL
Zero	**Pure Spectator**	
First	**Ergodic Observer**	
Second	**Pulsed Egocentric Interactor**	
Third	**Iterated Egocentric Interactor**	
Fourth	**Recursive Interactor**	

The major added value of this approach is provided by our new idea of system interaction, defined as inner and outer system information aggregation. It can allow both quick and raw system response (Reactive Management, to grow and survive) and slow and accurate information unfolding for future response strategic organization (Proactive Management, to adapt and prosper) by coherently formatted operating point (Fiorini & Santacroce, 2013b). Now, according to previous discussion, it is possible, at systemic level, to envisage a post-Bertalanffy Systemics Framework able to deal with problems of different complexity in a generalized way when interdisciplinarity consists, for instance, of a disciplinary reformulation of problems, like from biological to chemical, from clinical research to healthcare, etc., and transdisciplinarity is related to the study of such reformulations and their properties. For the first time, Social and Biomedical Engineering's ideal system categorization levels can be matched exactly to practical system modeling interaction styles, with no paradigmatic operational ambiguity and information loss, as shown in Figure 6 (specifically, our innovative system interaction modality, called "Recursive Interactor", corresponds to the fourth order biomedical cybernetics). Now, even new social and health information application can successfully and reliably manage a higher system complexity than contemporary ones, with a minimum of design constraints specification and less system final operative environment knowledge at design level. From an operational perspective, the previous complex multiscale Cybernetics framework with five levels can be mapped to the following five graphic modeling practical interaction styles respectively, with no operational ambiguity as depicted in Figure 6.

Specifically, advanced wellbeing applications (AWA), high reliability organization (HRO), mission critical project (MCP) system, very low technological risk (VLTR) and crisis management (CM) system can benefit highly from the newer CICT OUM approach and related techniques. The present paper is a relevant contribution towards a new Post-Bertalanffy General Theory of Systems, showing how homeostatic operating equilibria can emerge out of a self-organizing landscape of self-structuring attractor points.

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