

CYBERNETICS AND AUTOPOIESIS THEORY AS A STUDY OF COMPLEX ORGANIZATIONS. A SYSTEMIC APPROACH.

JOHN VELENTZAS¹ - GEORGIA BRONI²

Abstract

Cybernetics is the field of science concerned with management and organizations. The notion of cybernetics and management was first introduced by Stafford Beer in the late 1950s. It is a science of human interaction and communication and its main theory is the control theory. When cybernetics applicate and focus to organizations is called management cybernetics. Using the tenets of autopoietic theory, scientists interpret organizations as networks of interactions, reactions and processes and as a network of rules of coordination. Autopoiesis theory is close related to cybernetics because their methodological instruments are quite similar (language for communication, emotions for controlling, decision for intention). Sociocybernetics is a communication activity related with the previous matters because is to map, measure, harness and find ways of intervening in the parallel network of social forces that influence human behaviour. Sociocyberneticists task is to understand the guidance and control mechanisms that govern the operation of society. As conclusion, we agree that cybernetics is an interdisciplinary science and has held a dominant position as to physics or management, as much to computer science, to language and social studies.

JEL codes: K300

Key Words: [Cybernetics, Management Cybernetics, control theory, world of chaos, Organizations, living and nonliving systems, autopoiesis, Viable System Model, decision making, Sociocybernetics, emotions, language, social forces, karma Capitalism].

1. Introduction

Cybernetics was defined by the mathematician Norbert Wiener in 1947 as the science of communication and control in the animal and the machine. That is to say that cybernetics studies the flow of information round a system and the way in which that information is used by the system as a mean of controlling itself; it does this for the animate and inanimate systems indifferently (Jackson: 1988). For cybernetics is an interdisciplinary science, owing as much to biology as to physics, as much as the study of the brain as to the study of computers and owing also a great deal to the formal languages of science for providing tools with which the behaviour of all systems can be objectively described (Beer: 1966).

Cybernetics is not exactly a discipline. Rather, it should be thought of as an approach which helps thinkers and practitioners across a whole range of different disciplines secure a vantage from which they are likely to gain a more complete understanding of their own area of practice. Its focus is upon meaningful and effective action and behaviour in whatever the domain of human activity (Velentzas - Broni: 2009b:82).

Cybernetics is 'the conceptualization of a way of relating to one's world' (Hoebele: 1994).

In simple language, it deals with the relationship between subject (human observer / actor) and object (that which is observed by a subject). It specifically denies - or perhaps better, places limits upon - the tendency of western analytical science and religion to overly stress the separation of these two domains in the pursuit of objectivity (Velentzas - Broni: 2009b:80).

The insights of Cybernetics provide an experiential grounding, a way of orienting, both in terms of the world 'out there' and the world 'in here' (Velentzas - Broni: 2009a). This grounding embraces and informs human understanding of the physical, the psychological, the philosophical and the spiritual. As such it impacts on all the human and social sciences (Beer: 1959).

Distinct from the advocacy of any particular subject area or profession, Cybernetics is best thought of as encouraging emancipation and inclusion. Within any particular profession, subject area or discipline, Cybernetics poses questions for the practitioner, and suggests ways to make their ongoing practice more effective in their own domain of operations. This concerns shifting attention from things to the relations that can be either observed or inferred from the movement or flow of things in relation to other things. Such 'other things' might only be inferred from such relations, until later investigation confirms or disconfirms a particular hypothesis -this is called the scientific method (Liebscher: 1967:823).

In short, Cybernetics offers an optimistic yet realistic way of addressing the classical existentialist conundrum -'where is meaning in this world of chaos, angst and despair?'

Its fundamental premise -and indeed its findings- confirm the intrinsic order of the natural world and the potential for human beings through their own effective action and interactions with one another, to establish a fit with that coherence in their living. In this sense, it is possibly one of the earliest exponents of sustainability. For instance, Stafford Beer's Viable Systems Model (VSM) presents an archetypal model for sustainability (Beer: 1972).

Cybernetics perhaps allows us to mitigate against the tendency of political, cultural and social systems to engage each other in antagonistic relations which violently impact on human beings and the global eco-system.

When we peruse the various figures in this section, the fascinating thing is how these insights as to coherence emerged contemporaneous with the existential endeavour - indeed, were triggered by exactly the same data. The interpretation of contemporaneous findings in science that impacted so negatively on certain influential strands of western philosophy (such as relativity, quantum mechanics and uncertainty), had a very different impact on Cybernetics. This is an example of how interpretation of the data ('meaning') determines two very different insights into human reality.

Management cybernetics is the concrete application of natural [cybernetic](#) laws to all types of [organizations](#) and [institutions](#) created by human beings and to the [interactions](#) within them and between them (Plenert: 1995). It is a theory based on

¹ Associate Professor, Lawyer, TEI West Macedonia (e-mail: drjohnvel@gmail.com).

² Doctor of Philosophy, Teaching Fellow, TEI West Macedonia (e-mail: georgiabroni@yahoo.gr).

natural laws. It addresses the issues that every [individual](#) who wants to influence an organization in any way must learn to resolve (Espejo - Watt: 1988). This theory is not restricted to the actions of top [managers](#). Every member of an organization and every person who to a greater or lesser extent communicates or interacts with it is involved in the considerations (Beer: 1959).

Management cybernetics is founded and first developed by [Stafford Beer](#) since the 1960s. His management theory is not limited only to industrial and commercial enterprises (Peschke: 1979).

It also relates to the management of all types of organizations and institutions in the profit and non-profit sectors (Velentzas - Broni: 2010:92-93):

- from individual enterprises to huge multinationals
- in the private and public sector
- in associations and political bodies and
- lastly in professional and private life

Institutions in the sense of general legal and contractual regulations are also covered.

2. History

The earliest system models used in management studied organizations as mechanical systems in equilibrium. The idea of studying social systems in this way was originally derived from [Pareto](#) in 1919 and was promoted in the United States by [Henderson](#) at Harvard in the 1930s. Henderson saw organizations made up of parts in mutual interaction. From the 1930s onward three different models of management competed for precedence in organization theory - the traditional approach, human relation theory and systems theory (Jackson: 1991).

In 1948, [Wiener](#) published the book *Cybernetics*, bringing together ideas about control process. [Ashby](#) (1956) in his Introduction to *Cybernetics* noted that cybernetics should reveal parallels between machine, brain and society. It was the [Beer](#) with his *Cybernetics and management* in 1959 that got managers and management scientists interested (Jackson: 2000). According to Beer by then several attempts had been made to give a systematic exposition of the science of cybernetics, and had drawn attention to the relevance to various orthodox fields (Beer: 1959). Some [biologists](#) have been quick to realise the value of cybernetics to them. Some engineers too, were well aware of the importance of the subject to [engineering](#), and to [automation](#) in particular. The [social sciences](#) were conscious of their need for a formal framework of a cybernetic kind. [Economists](#), too, had seized a similar point. But the exposition of Beer's *Cybernetics and management* was the first directed to the relevance of cybernetics to industrial management (Beer: 1959).

Beer was the first to apply cybernetics to management, defining management as the 'science of effective organization'. Throughout the 1960s Beer was a prolific writer and an influential practitioner (Rosenhead: 2006). It was during that period that he developed the viable system model, to diagnose the faults in any existing organizational system. In that time [Forrester](#) (1961) invented [systems dynamics](#), which held out the promise that the behaviour of whole systems could be represented and understood through modelling the dynamical feedback process going on within them (Jackson: 2000).

Organizations as systems gradually developed to become the dominant approach in the 1960s and 1970s (Jackson: 1991). Systems people whether theorists or practitioners operated from within the same [paradigm](#). Summarizing greatly these systems of all types could be identified by empirical observation of reality and could be analyzed by essentially the same methods that brought success in the natural sciences. Systems could then, if the interest was in practice, be manipulated the better to achieve whatever purpose they were designed to serve. Systems thinking until the 1970s, therefore, was dominated by the positivism and functionalism characteristics of the traditional version of the scientific method. We can call this kind of systems the traditional systems approach. It embraces strands of work such as 'organizations as systems', [general systems theory](#), [contingency theory](#), [operations research](#), [systems analysis](#), [systems engineering](#), and management cybernetics (Jackson: 1991).

During the 1970s and 1980s traditional systems thinking became subject to increasing criticism. As a result alternative systems were born and flourished for example 'soft systems thinking', 'organizational cybernetics' and critical 'systems thinking' (Jackson: 1991).

3. Management cybernetics Topics

3.1 Control theory

The concept of control is of fundamental importance to organizations (Beer: 1959).

It has been identified as a significant influence (Green - Welsh: 1988; Velentzas - Mamalis - Broni: 2010:170; Broni: 2010:233-288)

- the formation of organizational strategy,
- the design of organizational structure,
- the selection, socialisation and evaluation of personnel and
- the ongoing process of leadership and motivation.

The concept of control itself is a subject of scientific reflection in Management cybernetics (Velentzas - Broni: 2009b:97).

With the years the definition of control has broadened. According to some its meaning has lessened. Originally the discussion of control to business organizations referred to monitoring employee behaviour. Over time a broader definition has developed making it synonymous with the concept of power and influences (Green - Welsh: 1988).

In the 1950s and 1960s, open systems theory, together with sociological systems theory, was enormously influential in providing a coherent framework for the study of organizations and their environments. These approaches were in important respects motivated by ideals of order, stability, and predictability. So influential were they that the paradigm they defined is still prevalent today. Although today's organizations and their environments are often characterized by transformation, emergence, much unpredictability, and a strong emphasis on people, the systems approach to understanding organizations is still not being conveyed in a coherent

manner, especially to students and managers (Kaya - Alderb - Brown - Houghton: 2003). The reason for this, in our view, is the lack of a unifying framework for explaining a spectrum of organizational phenomena, from stable to highly dynamic organizations and environments (Velentzas - Broni: 2010:194).

Autopoiesis is a concept developed in biology (Maturana - Varela: 1980:79-80) primarily as a construct which enabled a distinction to be made between living and nonliving systems (Maturana: 1988). The concept and its postulates have slowly been gaining ground and generating enthusiasm among many scientific communities (Zeleny: 2005). Autopoiesis is developing into a new theoretical paradigm (King: 1993) in the social sciences and suggest that autopoiesis offers the basis for a new general systems theory (Krogh - Roos: 1995).

The organization of the future needs an epistemology which is radically different from epistemologies that have guided organizational thinking and that autopoiesis theory, with due adaptations, can furnish such an epistemology by providing a brief overview of the key tenets of autopoiesis theory applied to organizational settings. Important challenges facing organizational thinkers, now and in the foreseeable future, exist not only as the result of the external pressures, but also as a consequence of internal developments in organization science and theory (Von Foerster: 1979).

3.2 Decision making

[Systems theory](#) and related areas such as [computer science](#), [information theory](#), and management cybernetics have long been devoted to the study of [decision-making](#). A common assumption of these areas is that all organisms are [information systems](#) (Skyttner: 2001).

The characteristics of a decision situation are (Skyttner: 2001):

- A [problem](#) exists.
- At least two alternatives for action remain.
- [Knowledge](#) exists of the objective and its relationship to the problem
- The consequences of the [decision](#) can be established and sometimes [quantified](#)

Decision making by management staff can also be practised in computerized business simulators that are made to resemble the ordinary decision environment as closely as possible (Sismondo - Gissis: 1999).

Beer's 'decision room' or Frontesterion is an example of such an environment (Beer: 1979).

4. Model

A model is a simplified abstract view of the complex reality. A scientific model represents empirical objects, phenomena, and physical processes in a logical way. Attempts to formalize the principles of the empirical sciences in the same way logicians axiomatize the principles of logic use an interpretation to model reality. The aim of these attempts is to construct a formal system for which reality is the only interpretation. The world is an interpretation (or model) of these sciences, only insofar as these sciences are true (Box - Draper: 1987).

For the scientist, a model is also a way in which the human thought processes can be amplified.

Models that are rendered in software allow scientists to leverage computational power to simulate, visualize, manipulate and gain intuition about the entity, phenomenon or process being represented.

4.1 Modelling as a substitute for direct measure and experimentation

Models are typically used when it is either impossible or impractical to create experimental conditions in which scientists can directly measure outcomes. Direct measurement of outcomes under controlled conditions will always be more accurate than modelled estimates of outcomes. When predicting outcomes, models use assumptions, while measurements do not. As the number of assumptions in a model increases, the accuracy and relevance of the model diminishes.

4.2 Modelling language

A modelling language is any artificial language that can be used to express information or knowledge or systems in a structure that is defined by a consistent set of rules. The rules are used for interpretation of the meaning of components in the structure³.

4.3 Simulation

A simulation is the implementation of a model over time (Fishwick: 1995). A simulation brings a model to life (Winsberg: 2001) and shows how a particular object or phenomenon will behave (Sokolowski - Banks: 2009). It is useful for testing (Winsberg: 2003) analysis or training where real-world systems or concepts can be represented by a model (Freudenthal: 1951).

4.4 Structure

Structure is a fundamental and sometimes intangible notion covering the recognition, observation, nature, and stability of patterns and relationships of entities. From a child's verbal description of a snowflake, to the detailed scientific analysis of the properties of magnetic fields, the concept of structure is an essential foundation of nearly every mode of inquiry and discovery in science, philosophy and art (Churchman: 1968).

³ Examples of modelling languages are the Unified Modeling Language (UML) for software systems, IDEF for processes and the VRML for 3-D computer graphics models designed particularly with the World Wide Web in mind.

4.5 Scientific Modelling

Scientific modelling is the process of generating abstract, conceptual, graphical and / or mathematical models. Science offers a growing collection of methods, techniques and theory about all kinds of specialized scientific modelling. Also a way to read elements easily which have been broken down to the simplest form.

Modelling is an essential and inseparable part of all scientific activity, and many scientific disciplines have their own ideas about specific types of modelling. There is little general theory about scientific modelling, offered by the philosophy of science, systems theory, and new fields like knowledge visualization.

Scientific models are not descriptors nor are they pointers toward some neutral, objective reality, but are consensual conventions which enable particular understanding and coordination of activity in a community of observers. Impeccable communication of a model entails making visible this active consensual function, rather than simply pursuing a more detailed investigation of the phenomenon considered as the source or origin for the model (Harnden: 1990).

The starting point for the management cybernetic model of the organization is the input - transformation - output schema. This is used to describe the basic operational activities of the enterprise. The goal or purpose of the enterprise is, in management cybernetics, invariably determined outside the system (as with a first-order feedback arrangement) (Beer: 1959). Then, if the operations are to succeed in bringing about the goal, they must, because of inevitable disturbance, be regulated in some way. This regulation is effected by management. Management cybernetics attempts to equip managers with a number of tools that should enable them to regulate operations (Beer: 1959). Chief among these are the black box technique and the use of feedback to induce self-regulation into organizations. The latter is often supplemented by strategic control, based on feed-forward information, and external control. Management cybernetics makes little use of the more complex, observer-dependent notion of variety, and organizational cybernetics (Jackson: 2000). [Stafford Beer](#) (1985) confirms variety as fundamental to matching resources to requirement and the measurement of performance.

5. Systems

A system is a set of interacting or interdependent entities, real or abstract, forming an integrated whole (Churchman: 1968). The concept of an 'integrated whole' can also be stated in terms of a system embodying a set of relationships which are differentiated from relationships of the set to other elements, and from relationships between an element of the set and elements not a part of the relational regime (Wolvekamp: 1996). Beer defined a system (Schwaninger: 2001) as anything that consists of parts connected together.

5.1 Viable System Model

The Viable Systems Model (VSM) is an [abstract model](#) of the organisational structure of any viable or [autonomous system](#) (Vidgen: 1998). A viable system is any system organised in such a way as to maintain its identity in a changing environment (Lewis: 1998). One of the prime features of systems (Blackstone - Gardiner: 1997) that survive is that they are adaptive. The VSM is a model for a viable system, an abstracted cybernetic description that is applicable to any organisation (Schwaninger: 2006).

Finally, Cybernetics is also a way of considering and thinking about things that can be used to analyze the thinking, communication, acting and functioning of human beings themselves and to give them an effective meaning. This approach is thus also helpful in overcoming communication problems between different experts and specialist areas.

'Viable systems' are those that [system](#) (Vidgen: 1998)

- can absorb and make use of information from their environment
- can adapt to their environment
- maintain their identity
- learn

The natural law of viability described by Stafford Beer applies both to biological and social systems. It also illustrates the fundamental difference between his view of organizations and management and conventional views. These views are often still expressed in popular organizational and business administration theory.

The science of Cybernetics has produced much that has had an impact on modern life. These include a wide range of mechanical and electronic automata and mechanisms of different types serving a variety of purposes, the invention of the computer, current information theory and the most effective forms of psychotherapy. In addition, many other current methods of problem solving in a wide range of different scientific disciplines are based on discoveries within Cybernetics. These include educational science, sociology, communications, mechanical engineering, environmental sciences and medicine.

Stafford Beer defines Cybernetics as 'the science of effective organization'. He himself in his management theories combines Cybernetics in particular with his practical experience and knowledge of neuropsychology, neurophysiology, computer science, communications, operations research, mathematics, formal logic and philosophy.

6. Close related fields

6.1 Entrepreneurial cybernetics

Similar to management cybernetics, entrepreneurial cybernetics is primarily concerned with applying the knowledge gained from general cybernetic theories applicable in everyday business contexts (Velentzas - Broni: 2010:161). Rules and methods for establishing and improving regulation, control and communication are focused on helping and supporting [small and medium-sized enterprises](#) (Beer: 1959). Such businesses act as a major driving force in many of today's economies and it is therefore important that entrepreneurial cybernetics offers them new ways of thinking and approaching business so that they can survive in increasingly complex and competitive markets (Velentzas - Mamalis - Broni: 2010:122).

6.2 Organizational cybernetics

Organizational cybernetics is distinguished from management cybernetics. Both uses many of the same terms but interpret them according to another philosophy of systems thinking. Organizational cybernetics by contrast offers a significant break with the assumption of the hard approach. The full flowering of organizational cybernetics is represented by Beer's [Viable System Model](#) (Jackson, 1991).

Organizational Cybernetics studies organizational design and the regulation and self-regulation of organizations from a systems theory perspective that also takes the social dimension into consideration. Researchers in economics, public administration and political science focus on the changes in institutions, organisation and mechanisms of social steering at various levels (sub-national, national, European, international) and in different sectors (including the private, semi-private and public sectors). Organizational Cybernetics has contributed to the analysis of what is arguably one of the most remarkable developments in modern societies in the past few decades: the transformation of traditional governing mechanisms ('government') and the advancement of new forms of 'governance'. This development is most obvious in the private, the semi-private and the public sectors and involves the local, regional, national, transnational, and global levels within these sectors.

6.3 Organization and Structure

In the organizational world, there are forces which are informal, enduring, and hard to change (cultural norms) and others which are formal, often ephemeral, and more amenable to adoption (processes, procedures, and tasks). The latter are inevitably influenced and shaped by the former. In organizational theory and research, these two kinds of forces are usually treated separately, because it is often very difficult to reconcile them, although from the point of the practitioner, this is always disappointing. Autopoiesis theory, however, offers organizational theorists and researchers new possibilities to address such disparate organizational phenomena in a much more integrated fashion. Take the concepts of organization and structure, for example. Within the autopoietic perspective, organization means necessary relationships or network of rules that govern relations between system components and that thereby define the system conceptually. Structure means the actual relations between the components that integrate the system in practice and that satisfy the constraints placed by the organization.

Using the tenets of autopoietic theory ([Zeleny: 2005](#)), he interprets organizations as networks of interactions, reactions and processes identified by their organization (network of rules of coordination) and differentiated by their structure (specific spatio-temporal manifestations of applying the rules of coordination under specific conditions or contexts). Following these definitions, Zeleny argues that the only way to make organizational change effective is to change the rules of behaviour (the organization) first and then change processes, routines, and procedures (the structure). He explains that it is the system of the rules of coordination, rather than the processes themselves, that defines the nature of recurrent execution of coordinated action (recurrence being the necessary condition for learning to occur). He states: 'Organization drives the structure, structure follows organization, and the observer imputes function'. [Espejo, Schumann, Schwaninger, and Bilello \(1996\)](#) adopt similar terminology, but instead of organization they refer to an organization's identity as the element that defines any organization, explaining that it is the relationships between the participants that create the distinct identity for the network or the group. Organization is then defined as 'a closed network of relationships with an identity of its own'. While organizations may share the same kind of identity, they are distinguished by their structures. People's relationships form routines, involving roles, procedures, and uses of resources that constitute stable forms of interaction. These allow the integrated use and operation of the organization's resources. The emergent routines and mechanisms of interaction then constitute the organization's structure. Hence, just like any autopoietic entity, organizations as social phenomena are characterized by both an organization (or identity) and a structure. The rules of interaction established by the organization and the execution of the rules exhibited by the structure form a recursive bond.

The adoption of autopoietic notions of organization and structure by conventional organization theory may create exciting new opportunities to establish theoretical and practical links between the structurally determined or 'engineered' parts of an organization, such as its business processes and the emergent properties arising from the actions and interactions of human actors that jointly shape the organization's identity. The understanding of the heterogeneous engineering ([Law: 1987](#)) of the multitude of soft and hard aspects of social organizations can greatly benefit from an elaboration of this dichotomy and the ways in which the two dichotomous parts interact and influence each other.

7. Sociocybernetics

Sociocybernetics (Geyer - van der Zouwen: 1992), is an independent chapter of science in sociology based upon the General Systems Theory (GST) and cybernetics.

Sociocybernetics is the science and art of steering societies.

Sociocybernetics is an application of GST and first-and second-order cybernetics to the social sciences.

Actually, sociocybernetics is to a large extent based on second-order cybernetics, which was developed precisely because first-order cybernetics had only a limited applicability to the social sciences, where the researcher himself forms part of the subject under investigation, in contrast with the natural sciences (von Foerster: 1979:5-8).

Sociocybernetics is an independent chapter of science in sociology based upon the [General Systems Theory](#) and [cybernetics](#).

It also has a basis in [Organizational Development](#) consultancy practice and in Theories of [Communication](#)⁴, theories of [psychotherapies](#) and [computer sciences](#).

The term 'socio' in the name of sociocybernetics refers to any [social system](#).

The idea to study society as a system can be traced back to the origin of sociology when the emergent idea of functional differentiation has been applied for the first time to society by [August Comte](#).

⁴ The International Sociological Association has a specialist research committee in the area which publishes the (electronic) Journal of Sociocybernetics.

The basic goal, why sociocybernetics was created, is to produce a theoretical framework as well as information technology tools for responding to the basic challenges individuals, couples, families, groups, companies, organizations, countries, international affairs are facing today.

An autopoietic system is defined as a system that is generated through closed organization processes of production such that the same organization of processes is reproduced through the interactions of its own products (components). Thus, the organization of components and component-producing processes may remain relatively invariant through the interactions and turnover of components. If an organization (the specified relations between components or processes) were to change substantially, there would not necessarily be a change in that system's identity. What would change is the system's structure (its particular manifestation in the given environment) within the degrees of freedom allowed by the specified relations between components. In this way, the development of a system's structure is done recursively. In order to enable the evolution of structure through such recursive behaviour - which is the essence of autopoiesis - the autopoietic system needs to be operationally closed ([Zeleny, 2003](#)).

[Mingers \(2001\)](#) argues that although autopoiesis cannot be applied as a whole to social theory, there are some key principles of autopoiesis that are applicable, namely the principle of an organization's operational closure. This argument is based on the assumption that throughout the entire hierarchy of systems proposed by [Boulding \(1956\)](#), all levels of systems exhibit characteristics of organizational closure. As we have explained above, in autopoiesis the main requirement for identifying living, autonomous systems is not the existence of a set of inputs and outputs, but an internal coherence that results from the interconnectedness of a system's inputs and outputs ([Varela, 1984](#)). In this respect, organizational closure 'requires some form of self-reference, whether material, linguistic, or social, rather than the more specific process of self-production'.

Organizational closure and self-referentiality are criteria that unequivocally define social systems. The various institutional systems and subsystems that make up a social system become closed domains of communication, autonomous and independent, while maintaining strong forms of interdependence (structural couplings) because they rely on each other to perform many societal functions. Interactions between subsystems are often quite well defined, for example, in business organizations. Communications about the environment may give rise to strategic marketing communications that, in turn, trigger communications among product development, capital budgeting, and production subsystems. Such communication activity arises from interactions among organizational actors that may enhance or constrain further communication activity.

7.1 Sociocybernetics analyzes social 'forces'

One of the tasks of sociocybernetics is to map, measure, harness and find ways of intervening in the parallel network of social forces that influence human behaviour. Sociocyberneticists' task is to understand the guidance and control mechanisms that govern the operation of society (and the behaviour of individuals more generally) in practice and then to devise better ways of harnessing and intervening in them – that is to say to devise more effective ways to operate these mechanisms or to modify them according to the opinions of the cyberneticist.

Sociocybernetics aims to generate a general theoretical framework for understanding cooperative behaviour

It claims to give a deep understanding of the General [Theory of Evolution](#). The outlook that Sociocybernetics uses when analyzing any living system lies in a Basic Law of SocioCybernetics (Raven: 1994; 1995).

It says: All [living systems](#) go through five levels of interrelations (social contracts) of its subsystems:

- A. Aggression: survive or die
- B. Bureaucracy: follow the norms and rules
- C. Competition: my gain is your loss
- D. Decision: disclosing individual feelings, intentions
- E. Empathy: cooperation in one unified interest

Going through these five phases of relationship theoretically gives the framework for the sociocybernetic study of any evolutionary system. It serves as an 'equation for life.'

8. Issues and challenges

Perhaps the most basic challenges faced by sociocyberneticians are those that stem from [Bookchin's](#) (2005) work 'The ecology of freedom: the emergence and dissolution of hierarchy'.

Bookchin's argument is that what have often been described as 'primitive' societies are best thought of as 'organic' societies. People within them have differentiated roles as do the cells of a body, but this differentiation is largely reversible. Coordination between the cells is not organized by some 'center' but through a network of feedback (cybernetic) processes. Particularly important are organisms' ability to evolve as well as reproduce. But simply saying that the process is '[autopoietic](#)' is to evade the task of identifying the multiple and mutually reinforcing cybernetic processes that are at work.

Yet Bookchin's claim, which appears to be thoroughly documented, is that the evolution of organic societies into our current, vastly destructive, hierarchical societies -over millennia- has also taken place through some (almost cancerous?) unstoppable autopoietic process. If we are to halt this process, which is about to destroy us as a species, probably carrying the planet as we know it with us, it will be necessary to map and find ways of intervening in the sociocybernetic processes involved. No centralised system-wide, command-and-control oriented, change will suffice. Systems intervention requires complex systems-oriented intervention targeted at nodes in the system, not system-wide change based on 'common sense'.

8.1 Criticism

[Jackson](#) stated that, management cybernetics represents little advance on hard systems thinking and is subject to the same criticisms. There is little to choose between the two. Conventional management scientists are able to take cognizance of its insights and to employ concepts such as feedback in their traditional analyses. Management cybernetics, therefore, offers no new direction in

systems thinking. Whether based on a machine analogy or on a biological analogy, it can be criticized for exactly the same reasons as hard systems thinking, an inability to deal with subjectivity and with the extreme complexity of organizational systems, and for an inherent conservatism (Jackson: 2000).

Human beings are autopoietic, which means that as individuals we are all operationally closed. To illustrate, we have all experienced occasions when no matter what we say and explain to our dialoguing counterpart, he or she is unable to comprehend our point of view. This situation can last for a few minutes, or hours, or may endure for years and even lifetimes. Operational closure can be observed in our daily interactions at work, in the shopping mall, and in the family. The only way to overcome autopoietic closure is by building structural couplings. The nature and degree of structural coupling that emerges when two or more individuals interact is a defining feature of the macro system of invisible rules and procedures that characterize social institutions.

Organizational closure, however, should not be confused with the notions of 'closed' and 'open' systems from traditional systems theory. [Maula \(2006\)](#) argues that openness and closure are not only simultaneous phenomena, but they also necessitate each other. In other words, there are no environmentally 'closed' systems. An organizational closed system cannot be completely closed to its environment, because it cannot be completely unresponsive to environmental signals and perturbations. Organizational closed systems are therefore closed with respect to their own organization and structure, but they may nevertheless maintain intense interactions with the environment. Through recurrent environmental signals, perturbations, and triggers, a system becomes coupled to its environment. Such coupling is achieved through changes in the system's structure, even while the organization remains autonomous and closed ([Zeleny: 2003](#)).

8.2 Language and Linguaging

[Von Krogh and Roos \(1995b\)](#) made one of the most significant contributions to integrate autopoiesis into management theory and research. In so doing, they advanced an anticognitivist position in the organizational knowledge debate. They reject the notion that knowledge is a given and that the task of organizational systems is to represent it as accurately as possible. Instead, they argue that knowledge is embodied in human beings and these representations of the world in the human mind come forth as a result of actions or observations by human beings. This point is illustrated by the often cited statement by [Maturana and Varela \(1992\)](#), 'Knowledge is what brings forth a world'. For example, imagine that you are about to enter an office that is new to you. Your experience (knowledge) tells you to take an initial sweeping look in order to locate the reception desk, your assumed point of entry into the inner circles of the office. Having located what you believe is the reception desk (world) you take the first steps towards the desk. In doing this you get a glimpse of a corridor on your right-hand side in which you see a door and on which you locate a name plate (world). You recognize the name on the door to be the person you are supposed to visit (knowledge).

The ideas that the world is brought forth in knowledge and that knowledge is not abstract but is embodied in human action frame the discussion about individual versus organizational knowledge ([Sanchez: 2001](#); [Sanchez - Heene: 2006](#)). [Von Krogh and Roos \(1995a\)](#) argue that the bridge between socialized and individualized knowledge is achieved by means of language. Language is what allows action to be coordinated in the organization and such coordination is achieved through organizational members making useful distinctions about the organization (an important form of organizational learning). The first and broadest distinction is the concept of 'organization' itself. Linguistically, the organization has to be distinguished from its environment. The emergence in social interactions of a new entity, in this case the organization, presupposes a languaging capability. Organizational members conceive of the organization they are working for through language and from this very broad distinction (the organization from the environment) finer distinctions can start to be made. For example, there will be linguistic distinctions associated with the concept of 'product' in a given organization. In this way, an organization develops its own languaging process and resulting language that conveys its own system of meaning. An organization's language-enabled system of meaning, in turn, develops its own autopoiesis.

'Languaging' is the expression used by Maturana and Varela (1980, 1992) to denote the act of using language. Given its dynamic nature, languaging fulfils a dual but conflicting function. On one hand, because languaging contributes to creating a unique identity for an organization (language is integral to its culture), languaging can be instrumental in bringing about change. On the other hand, language is important in maintaining the status quo and may thereby be a source of resistance to change, given the self-referential nature of autopoietic systems. Hence, 'to allow for rules and languaging that give way for effective action' ([von Krogh - Roos: 1995a:101](#)) is one of the main goals for and functions of socialized organizational knowledge. [Von Krogh and Roos \(1995\)](#) suggest that knowledge development in organizations comes about through the innovative use of old and new words and concepts - for example, through managerial efforts to shape language development in an organization.

8.3 Emotions and Emotioning

One form of communication in organizations is the conversations that can take place between two or more persons (Velentzas - Mamalis - Broni: 2010:60). When conversations happen and become recurrent among the same group of people, a social network, group, or community is formed. Conversations allow a structuration process ([Giddens: 1984](#)) to evolve, and once the structure of the network is formed, conversations become organizationally closed and self-referential. Metaphorically speaking, conversations have embedded in them the genetic code of a social network, through the three elements of structure - signification, domination, and legitimation ([Giddens: 1984](#)). The internal dynamics, roles, and values of networks, groups, and communities develop through conversations. Hence, for a newcomer to become part of a group - a behavioural domain - he / she has to learn, through participation, the group's genetic code and his / her role that is implicit in it. In this way, the social individual becomes structurally coupled to the social network.

Social membership means accepting the unwritten rules of a group and (thereby) being accepted by the group. Without mutual acceptance on some basis, cooperation and social action are not possible. Social boundaries, social norms, and emerging social practices transcend the individual and remain even after individuals have departed. Particular members may join or leave, but the social organization carries on. Moreover, organizations are based on self-transcendence - the reaching out beyond one's own existence in order to create shared understandings with others. In empathizing with colleagues or customers in the process of

socialization, the boundaries between individuals are diminished. In the process of committing to a group and becoming part of the group, the individual transcends the boundaries of the self. In the process of internalizing organizational knowledge, individuals cross the boundaries and enter the domain of the group or an organization ([Nonaka; 2001](#)).

The notion of boundaries of social systems implies a complementary notion of organizational contexts. Context can be understood as a situation in which individuals, work teams, or an organizational unit exerts a significant influence on internal and external interpersonal relationships. [Maturana \(1988\)](#) argues that emotions form the background for the embodiment of all our knowledge and thus cannot be separated from logical thought in everyday action. For Maturana, emotions are the ingredient that makes all social phenomena possible, through mutual acceptance. However, in our western-style management we have evolved a paradigm that encourages the separation of logic and emotion. One of the earlier voices to denounce this state of affairs was [Selznick \(1957\)](#): 'The importance of values is affirmed but the choice of goals and of character-defining methods is banished from the science of administration'. However, this situation may be changing - for example, through the emergence of the idea of karma capitalism as exemplified by the notions of soft power and smart power put forward by [Nye \(2008\)](#). Such movements suggest that there is a renewed perception of the importance of intangible elements like attitudes, emotions, and values in the workplace. The merging of the economic and emotional contexts of firms, for example, is at the heart of the holistic representation of firms in new strategic management theory ([Sanchez - Heene: 2004](#)).

9. Conclusion

In the 1960s, open systems theory, a breakthrough in the biological sciences ([Von Bertalanffy: 1950](#)), made its way into the organization sciences through the seminal work of [Katz and Kahn \(1966\)](#) and has held a dominant position ever since. Many of the tenets of open systems now need to be revisited, but so far there has not been an alternative perspective as powerful or influential in organization theory. Although autopoiesis has been heralded by many as a new systems theory, it has not yet achieved the same kind of impact as open systems thinking, in large part because there is no clear-cut agreement among organization scholars regarding the role or the place of autopoiesis in organization science.

Nevertheless, there has been a considerable amount of literature on autopoiesis in organization studies. While some authors have adhered to the qualified approach of Luhmann (1994), others have taken autopoiesis straight from the realm of the biological sciences to organization studies and have even combined it with other approaches (Hernes - Bakken: 2003). The result has been a number of proposals, some cautioning observation and interpretation, others supporting analysis and direct intervention, but none attempting to elaborate an integrated or comprehensive approach (Mingers: 2002).

1. Can autopoiesis provide the backdrop for a new organizational paradigm?
2. Framed within the complexity paradigm, can autopoiesis provide the metalanguage for a new theory of organization and management?
3. What might be the role of autopoiesis in the turn toward a focus on practice and transdisciplinarity in organizational thinking?
4. How might autopoiesis theory lend further support to the views supporting the networked nature of organizations and organizing?
5. Given its holistic nature, can autopoiesis provide a suitable framework for the integration of IT/IS into social organizations?

James [March \(2007\)](#) suggests that the field of organization studies may be entering a fourth 'invasion' era characterized by the growing influence of information technologies and biological advancements on social life and by the earth's declining ability to sustain the current conduct of the rapidly growing human species. We agree with this broad assessment and suggest that four trends will be decisive in shaping the organization of the future:

- The earth's declining capacity to sustain the current practices of the human species,
- Technical and social networking as the basis for decentralized, autonomous organizational forms,
- A world fuelled by ubiquitous, real-time data and information.

In particular, we suggest that the environmental issues associated with global warming are bound to have a marked effect on many aspects of organizations and organizational life. A central challenge for organization researchers therefore will be to understand how organization studies can contribute toward a world that is sustainable, not only in business terms, but more fundamentally in terms of the survival of the human species. The role of organizations in dealing with the earth's declining ability to sustain the human species will depend to a large degree on the approaches and concepts adopted by organization's managements on a global scale.

A related trend is the emergence of new attitudes and values in capitalism as a basis for economic organization, as exemplified by the development known as karma capitalism. The growing awareness of environmental issues that at least some corporations have been displaying in recent years is helping to bring about a new business ethos, which can be characterized as a more socially, environmentally and morally concerned approach to business. In the past many companies would bow only to the demands of their shareholders and customers; increasingly, however, companies are forced to consider their impact on everyone with a direct or indirect interest. Growing numbers of business scholars are advising executives to pursue broader purposes than just making money and are urging companies to take a more holistic approach to business, taking into account the needs of shareholders, employees, customers, society and the environment ([Sanchez - Heene: 2004](#)).

Developments like karma capitalism reflect the convergence of many global trends. However, capitalism is also changing from within the firm, often leading to dramatic changes in the relationship between the firm and the individual. Such changes are captured in the notion of the individualized corporation as proposed by [Ghoshal and Bartlett \(1998\)](#). More than ever before in some firms, the individual worker is becoming the center of management concerns. This trend is due to the ongoing shift in the economy from traditional industries based on manual workers to new enterprises based on knowledge workers who are now the crucial asset in many businesses. At the same time, while many corporations can no longer guarantee employment, growing numbers of knowledge workers no longer need or are even concerned about guaranteed employment. As a result, the nature of the bond between the organization and its employees is changing radically, and the notion of a 'moral contract' between a firm and its employees is beginning to replace legal contracts as the basis for employment ([Ghoshal - Bartlett: 1998](#)).

The organizational world is also being transformed by phenomena that run counter to the traditional command and control model of organization. Although the idea of the 'networked organization' has been a topic of discussion for a couple of decades, we are now entering an era in which we can observe real decentralized, autonomous, networked organizations on a global scale. What is important in this development is that not only organizations as institutions are able to network with other organizations, but people are now able to network person-to-person as never before. Internet and mobile telecom technologies are enabling people to meet and to coordinate their activities in ways that are profoundly affecting their lives, both professional and private. Perhaps the best example of the positive potential of a global, decentralized, autonomous, networked organization is the World Wide Web (www). However, where individual networking capabilities seem to play a predominant role in organizing, show that such developments are not limited to corporate or high-tech domains. These examples not only follow a decentralized, networked form, but also lack any kind of conventional management structure. In a similar manner, the Linux phenomenon has no formal structure, employees, or budgets, and its product is free. Yet Linux is already posing a serious threat to the largest software firms in the world ([Hernes - Bakken: 2003](#)). We human beings are not rational animals; we are emotional, languaging animals that use the operational coherences of language, through the constitution of rational systems, to explain and justify our actions, while in the process and without realizing it, we blind ourselves about the emotional grounding of all the rational domains that we bring forth ([Maturana: 1988](#)).

10. References

- Adler, P.S. - Kwon, S.W. (2002), 'Social capital: Prospects for a new concept', *Academy of Management Review*, Vol. 27: 141.
- Argyris, C. (1977), 'Double loop learning in organizations', *Harvard Business Review*, Vol. Sept.-Oct: 115-124.
- Ashby, W.R. (1956), *An introduction to cybernetics*, Chapman and Hall, London.
- Axelrod, R. - Cohen, M.D. (2000), *Harnessing complexity: Organizational implications of a scientific frontier*, Basic Books, New York.
- Barnard, C.I. (1938/68), *The functions of the executive*, Harvard University Press, Cambridge, MA.
- Barney, J.B. (1991), 'Firm resources and sustained competitive advantage', *Journal of Management*, Vol. 17: 99-120.
- Beer, S. (1959), *Cybernetic and Management*, English Universities Press.
- Beer, S. (1966), *Decision and Control: The Meaning of Operational Research and Management Cybernetics*.
- Beer, S. (1972), *Brain of the Firm*, Beer Allen Lane.
- Beer, S. (1979), *The Heart of Enterprise*, John Wiley, London and New York.
- Blackstone, J.H. - Gardiner, L.R. - Gardiner, S.C. (1997), 'A framework for the systemic control of organizations', *International Journal of Production Research*, Vol. 35: 597-609.
- Blau, P.M. (1970), 'A formal theory of differentiation in organizations', *American Sociological Review*, Vol. 35: 201-218.
- Bookchin M. (2005), *The Ecology of Freedom: The Emergence and Dissolution of Hierarchy*, Oakland, Ca, Ak Press.
- Boulding, K.E. (1956), 'General systems theory: The skeleton of science', *Management Science*, Vol. 2: 197-208.
- Broni G. (2010), *Leadership issues*, [in greek], IuS
- Burt, R. (1997), 'The contingent value of social capital', *Administrative Science Quarterly*, Vol. 42: 339-365.
- Burt, R. (2000), *From control to drift*, Oxford University Press, Oxford.
- Churchman, C.W. (1968), *The Systems Approach*, New York: Dell.
- Conner, K. (1991), 'A historical comparison of resource-based theory and five schools of thought within industrial organization economics', *Journal of Management*, Vol. 17: 121-154.
- Conner, K. (1996), 'A resource-based theory of the firm: Knowledge versus opportunism', *Organization Science*, Vol. 7: 477-501.
- Dimaggio, P. (1983), 'The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields', *American Sociological Review*, Vol. 48: 147-160.
- Espejo, R. - Schumann, W. - Schwaninger, M. - Bilello, U. (1996), *Organizational transformation and learning: A cybernetic approach to management*, Wiley, Chichester.
- Espejo R. - Watt J. (1988), 'Information Management, Organization and Managerial Effectiveness', *Journal of the Operational Research Society*, Vol. 39: 7-14.
- Fayol, H. (1949), *General and industrial management*, Pitman, London.
- Fishwick, P.A. (1995), *Simulation Model Design and Execution: Building Digital Worlds*, Upper Saddle River, NJ: Prentice Hall.
- Forrester J.W. (1961), *Industrial Dynamics*, Waltham, MA: Pegasus Communications.
- George, E.P. - Box, N. - Draper, N. (1987), *Empirical Model-Building and Response Surfaces*, Wiley.
- Ghoshal S. - Bartlett C.A. (1998), *The individualized corporation: A fundamentally new approach to management*, Heinemann, London.
- Green, S.G. - Welsh M.A. (1988), 'Cybernetics and Dependence: Reframing the Control Concept', *Academy of Management Review*, Vol. 13: 287-301.
- Gibbons, M. - Limoges, C. - Nowotny, H. - Schwartzman, S. - Scott, P. - Trow, M. (Eds) (1994), *The new production of knowledge: The dynamics of science and research in contemporary societies*, London: Sage Publications.
- Giddens, A. (1984), *The constitution of society: Outline of the theory of structuration*, Polity Press, Cambridge.
- Goldspink, C. - Kay, R. (2004), 'Bridging the micro-macro divide: A new basis for social science', *Human Relations*, Vol. 57: 597-618.
- Gouldner, A.W. (1954), *Patterns of industrial bureaucracy*, Free Press, Glencoe, IL.
- Grant, R.M. (1991), 'The resource-based theory of competitive advantage: Implications for strategy formulation', *California Management Review*, Vol. 33: 114-135.
- Hannan, M.T. - Freeman, J. (1977), 'The population ecology of organizations', *American Journal of Sociology*, Vol. 82: 929-964.

- Hanseth, O. (2004), Knowledge as infrastructure, Oxford University Press, Oxford.
- Harndern, R.J. (1990), 'The languaging of models', *Systemic Practice and Action Research*, Vol. 3: 289-302.
- Hernes, T. - Bakken, T. (2003), Introduction: Niklas Luhmann's autopoietic theory and organization studies - A space of connections, Copenhagen Business School Press, Copenhagen.
- Hoebele, L. (1994), *Making Work Systems Better - A Practitioner's Reflections*. John Wiley & Sons, Chichester.
- Jackson, M.C. (1988), 'Some Methodologies for Community Operational Research', *The Journal of the Operational Research Society*, Vol. 39: 715-724.
- Jackson, M.C. (2000), *Systems Approaches to Management*, Kluwer / Plenum, New York.
- Kakabadse, N. (1999), *Essence of leadership*, International Thomson Business Press, London.
- Katz, D. - Kahn, R.L. (1966), *The social psychology of organizations*, Wiley, New York, NY.
- Kaya, R. - Alderb J. - Brown D. - Houghton P. (2003), 'Management Cybernetics: A New Institutional Framework for Coastal Management', *Coastal Management*, Vol. 31: 213-227.
- King, A. (1993), 'The truth about autopoiesis', *Journal of Law and Society*, Vol. 20: 218-236.
- Latour, B. (2005), *Reassembling the social: An introduction to actor-network theory*, Oxford University Press, Oxford.
- Law, J. (1987), 'On the social explanation of technical change: The case of the Portuguese maritime expansion', *Technology and Culture*, Vol. 28: 227-252.
- Lawrence, P.R. - Lorsch, J.W. (1967), *Organization and environment: Managing differentiation and integration*, Graduate School of Business Administration, Harvard University, Boston, MA.
- Lewis, G. J. (1998), 'A cybernetic view of environmental management: the implications for business organizations', *Business Strategy and the Environment*, Vol. 6: 264-275.
- Lewin, R. (1992), *Complexity: Life on the edge of chaos*, Phoenix Paperbacks, London.
- Liebscher, H. (1967), 'Kybernetik und Methodik methodologischer Forschung', *Deutsche Zeitschrift für Philosophie*, 15, Nr. 7 821-827
- Luhmann, N. (1994). *Soziale Systeme. Grundriss einer allgemeinen Theorie*, Suhrkamp Verlag, Frankfurt.
- Magalhães, R. (2004), *Organizational knowledge and technology: An action-oriented approach to organization and information systems*, E. Elgar, London.
- Magalhães, R. - Sousa, P. - Tribolet, J. (2008), 'The role of business processes and enterprise architectures in the development of organizational self-awareness', *Revista de Estudos Politecnicos*, 4(9): 9-30.
- Mahoney, J.T. (1995), 'The management of resources and the resource of management', *Journal of Business Research*, Vol. 33: 91-101.
- March, J (2007), 'The study of organizations and organizing since 1945', *Organization Studies*, Vol. 28: 9-19.
- March, J.G. - Simon, H.A. (1958), *Organizations*, Wiley, New York.
- Maturana, H.R. (1988), 'Reality: The search for objectivity or the quest for a compelling argument', *Irish Journal of Psychology*, Vol. 9: 25-82.
- Maturana, H.R. - Varela, F.J. (1980), *Autopoiesis and cognition: The realization of the living*, Shambhala, Boston, MA.
- Maula, M. (2006), *Organizations as learning systems: Living composition as an enabling infrastructure*, Elsevier, Oxford.
- Mayo, E. (1945), *The social problems of an industrial civilization*, Graduate School of Business Administration, Harvard University, Boston, MA.
- McKelvey, B. (1997), 'Quasi-natural organization science', *Organization Science*, Vol. 8: 352-380.
- Meyer, J.W. - Rowan, B. (1977), 'Institutionalized organizations: Formal structure as myth and ceremony', *American Journal of Sociology*, Vol. 83: 340-363.
- Miller, E.J. - Rice, A.K. (1967), *Systems of organizations*, Tavistock, London.
- Mingers, J. (2001), *Information, meaning and communication: An autopoietic approach*, Greenwood Press, Westport, CT.
- Mingers, J. (2002), 'Can social systems be autopoietic? Assessing Luhmann's social theory', *The Sociological Review*, Vol. 50: 278-299.
- Mingers, J. (2004), 'Can social systems be autopoietic? Bhaskar's and Giddens's social theories', *Journal for the Theory of Social Behaviour*, Vol. 13: 403-427.
- Morgan, G. (1997), *Images of organization*, Sage, Thousand Oaks, CA.
- Nahapiet, J. - Ghoshal, S. (1998), 'Social capital, intellectual capital and the organizational advantage', *Academy of Management Review*, Vol. 23: 242-266.
- Nye, J.S. (2008), *The powers to lead: Soft, hard, and smart*, Oxford University Press, Oxford.
- Orton, J.D. - Weick, K.E. (1990), 'Loosely coupled systems: A reconceptualization', *Academy of Management Review*, Vol. 15: 203-223.
- Pfeffer, J. - Salancik, G.R. (1978), *The external control of organizations: A resource dependence perspective*, Harper & Row, New York.
- Plenert, G. (1995), 'Management cybernetics: total quality management', *Kybernetes*, Vol. 24: 55-59
- Pondy, L.R. - Mitroff, I. (1979), *Beyond open systems models of organization*, JAI Press, Greenwich, CT.
- Prahalad, C.K. - Krishnan, M.S. (2008), *The new age of innovation*, McGraw Hill, New York.
- Pugh, D.S. - Hickson, D.J. - Hinings, C.R. (1969), 'An empirical taxonomy of structures of work organizations', *Administrative Science Quarterly*, Vol. 14: 115-126.
- Sanchez, R. - Heene, A. (2004), *The new strategic management: Organization, competition, and competence (textbook)*, Wiley, New York.
- Sanchez, R. - Mahoney, J.T. (1996), 'Modularity, flexibility, and knowledge management in product and organization design', *Strategic Management Journal*, Vol. 17: 63-76.

- Schwaninger, M. (2001), 'System theory and cybernetics: A solid basis for transdisciplinarity in management education and research', *Kybernetes*, Vol. 30: 1209-1222.
- Schwaninger, M. (2006), 'The Evolution of Organizational Cybernetics', *Scientiae Mathematicae Japonicae*, Vol. 64: 405-420.
- Scott, W.R. - Davis, G.F (2007), *Organizations and organizing: rational, natural and open systems perspectives*, Pearson Education, Upper Saddle River, NJ.
- Selznick, P. (1949), *TVA and the grass roots. A study of politics and organization*, University of California Press, Berkeley, CA
- Selznick, P. (1957), *Leadership in administration*, Harper & Row, New York.
- Senge, P. (1990), *The fifth discipline: The art and practice of the learning organization*, Century Business, London.
- Simon, H. (1945/1997), *Administrative behaviour*, The Free Press, New York.
- Sokolowski, J. A. - Banks, C.M. (2009), *Principles of Modeling and Simulation*, Hoboken, NJ: John Wiley and Sons.
- Symons, V.J. (1991), 'Impacts of information systems: Four perspectives', *Information and Software Technology*, Vol. 33: 181-190.
- Taylor, F.W. (1911), *The principles of scientific management*, Harper & Brothers, New York.
- Trisoglio, A. (1995), *Managing complexity*. Unpublished working paper presented at the Strategy and Complexity Seminar, London School of Economics, London.
- Varela, F.J. (1984), *Two principles of self-organization*, Springer Verlag, New York, NY.
- Varela, F.J. - Thompson, E. - Rosch, E. (1991), *The embodied mind*, MIT Press, Cambridge, MA.
- Velentzas, J. - Broni, G. (2009a), *Cybernetics as Systemic Science: Semantics, Information & Communication* [in greek], IuS.
- Velentzas, J. - Broni, G. (2009b), *Cybernetics as Systemic Science, I*, [in greek], IuS.
- Velentzas, J. - Broni, G. (2010), *Cybernetics as Systemic Science, II*, [in greek], IuS.
- Velentzas, J. - Mamalis S. - Broni, G. (2010), *Communication, Public Relations & Advertisement*, [in greek], IuS.
- Vidgen, R (1998), 'Cybernetics and business processes: using the viable system model to develop an enterprise process architecture', *Knowledge and Process Management*, Vol. 5: 118-131.
- Von Bertalanffy, L. (1950), *The theory of open systems in physics and biology*, Penguin, Harmondsworth.
- Von Foerster, H. (1979), *Cybernetics of Cybernetics*, in: Krippendorff K. (Hrsg.), *Communication and Control in Society*, Gordon and Breach, New York, 5-8.
- Von Krogh, G. - Roos, J. (1995a), *Organizational epistemology*, Macmillan, Basingstoke.
- Von Krogh, G. - Roos, J. (1995b), 'Conversation management', *European Management Journal*, Vol. 13: 390-394.
- Weber, M. (1947), *The theory of social economic organizations*, Oxford University Press, London.
- Weick, K.E. (1976), 'Educational organizations as loosely coupled systems', *Administrative Science Quarterly*, Vol. 21: 1-19.
- Weick, K.E. (1979), *The social psychology of organizing*, Addison-Wesley, Reading, MA.
- Wernerfelt, B. (1984), 'A resource-based view of the firm', *Strategic Management Journal*, Vol. 5: 171-180.
- Wernerfelt, B. (1995), 'The resource-based view of the firm: Ten years after', *Strategic Management Journal*, Vol. 16: 171-174.
- Whittington, R. (2006), 'Completing the practice turn in strategy research', *Organization Studies*, Vol. 27: 613-634.
- Whyte, W.F. (1959), *Man and organization*, Richard D. Irwin, Homewood, IL.
- Winsberg, E. (2001), 'Simulations, Models and Theories: Complex Physical Systems and their Representations', *Philosophy of Science*, Vol. 68 (Proceedings): 442-454.
- Winsberg, E. (2003), 'Simulated Experiments: Methodology for a Virtual World', *Philosophy of Science*, Vol. 70: 105-125.
- Williamson, O.E. (1975), *Markets and hierarchies: Analysis and antitrust implications*, Free Press, New York.
- Wolvekamp H.P. (1996), 'The concept of the organism as an integrated Whole' *Dialectica* 20: 196-214.
- Woodward, J. (1965), *Industrial organization: Theory and practice*, Oxford University Press, New York.
- Zeleny, M. (2003), *Knowledge and self-production processes in social systems*, F. Parra-Luna (Eds), Oxford.
- Zeleny, M. (2005), *Human systems management: Integrating knowledge, management and systems*, World Scientific Publishing, Singapore.

