Conceptos y fenómenos fundamentales de nuestro tiempo

UNAM

UNIVERSIDAD NACIONAL AUTÓNOMA DE MÉXICO

INSTITUTO DE INVESTIGACIONES SOCIALES

AN AGENDA FOR SOCIOCYBERNETICS

FELIPE LARA ROSANO

AN AGENDA FOR SOCIOCYBERNETICS

Por Felipe Lara Rosano

Abstract

We propose to adopt the complex systems approach as well as social practice and social analysis theories based on the interaction of the social systems elements, self-organization processes and social emergence as the new approach to Sociocybernetics. Based on these considerations in this paper an agenda for the Sociocybernetics is proposed in order to provide the basis for a meta-methodology of social complexity.

Keywords: Sociocybernetics, social practice, complex systems

Introduction

The solution of social problems is a function of taking the right methodological approach, as well as applying the most advanced theories and techniques of social analysis (Crone 2011). In fact, this is the only way to sustainable development, to distribute more equitably the social contributions and benefits to the population and to face the threats of globalization taking advantage of the opportunities.

Contemporary societies are in constant interaction with every kind of turbulent environments, both natural and social. Moreover they are affected by internal and external conditions whose impacts depend from the social structure and the decisions to be taken at the internal and external level. Some of these conditions are the vulnerability of the majority of countries in front of the interests of the dominating global powers, the lack of social, economic, regional and cultural internal integration of most countries, a polarization of the national and regional income and an unfair income distribution in terms of costs and social benefits producing a large excluded poor population.

For all this, our social, economic and political problems are difficult to solve with traditional reductionist approaches and its treatment by traditional theoretical analysis and the linear theories associated with planning and management is very limited (Wallerstein 1999).

In fact, social systems should no longer be regarded simply as reactive, linear systems, explainable and manageable by narratives and common sense but be approached as dynamic, nonlinear, far from equilibrium, interactive systems, capable of adaptation, learning and innovation, with a tendency to auto organize themselves in complex networks (Byrne 1998).

This new approach has been introduced and developed by Sociocybernetics and expanded by the Complex Systems movement.

First and second order cybernetics

The term Cybernetics comes from the Greek KYBERNETOS, which means the control man, the pilot,

Antecedents of Cybernetics are found in the work of Köhler (1927). He presents a theory of regulation and control in inorganic systems, comparing them with the organic ones. Lotka (1925) introduces the general concept of system, not restricted to physical systems, but including both biological and social systems. Canon (1929) develops the concept of homeostasis and Von Bertalanffy starts working on a general systems theory, in the early 30's.

In 1943, Rosenblueth, Wiener and Bigelow suggested different ways to give machines purposes, i.e. to make them teleological. However, it was not until the end of the Second World War that emerges the cybernetic-systemic thinking with the birth of general systems theory (Von Bertalanffy 1968) and cybernetics (Wiener and Rosenblueth 1948), defined as the study of information and control mechanisms in living beings and machines. Social systems researchers like Talcott Parsons and Jay Forrester adopt the categories of positive and negative feedback as fundamental concepts in analyzing social dynamics.

Cybernetics questioned the traditional causality point of view, introducing the notion of circular causality. However it maintained the objective knowledge principles of traditional science: “The researcher is an observer situated outside of the observed object” and “The properties of the observer must not influence the description of his observations”.

It was Heinz Von Foerster the cybernetitian who in the seventies questioned this first cybernetic framework and its utility not only to solve social problems, but even to perceive them: “How is it possible for an observer to describe an object, if he has not the required properties to make (to influence) the description?” (Von Foerster 1979). He extended the concept of Cybernetics to solve these issues, defining the first-order cybernetics as the classical cybernetics of observed systems and the second-order cybernetics as the cybernetics of observing systems. In fact, social systems are self-observing, because they can reflect on themselves and change the way they behave in relation to themselves and their observers. To this framework belong concepts like self-organization, self-reference and auto-catalysis. With this new framework it was natural to approach social systems, where the researcher is a part of the social system and an active contributor to analyze and solve social problems from within.

The Sociology community however remained outside from these developments. Only Walter F. Buckley, an american sociologist, tried to convince sociologists not only to adopt the systems approach and the cybernetical concepts but to integrate the second-order cybernetics with the ideas of sociology in order to develop a new social systems field. Buckley conceived social systems as dynamical systems adapting to changing environment through morphostasis and morphogenesis. These concepts prepared the extension of the biological property of autopoiesis (Varela & Maturana 1974) to social systems.

At the end of the seventies a small group of scholars headed by Francisco Parra-Luna and including Felix Geyer, Kenneth D. Bailey and Johannes van der Zouwen took the pioneering ideas of Buckley and began to work in a new field located in the intersection of sociology and the cibernetical approaches that was called Sociocybernetics. Thanks to the pioneering efforts of Parra-Luna this new field was recognized by the International Sociological Association as an independent research group in 1980, becoming the research committee RC-51 in 1998 . According to the Center for Sociocybernetics Studies Bonn, Sociocybernetics is the application of systems thinking and cybernetic principles in sociology and other social sciences in order to analyse social phenomena regarding their complexity and dynamics. That means that Sociocybernetics is observing the way sociology observes and analizes Society. Sociocybernetics is in fact a third-order cybernetics.

Meanwhile a new approach to social systems emerged: the Niklas Luhman's approach (Luhmann 1984) characterized by considering social systems composed not by human beings but by communications. Today's society is the largest system encompassing the communications of the whole world. Luhmann adopts the Maturana's biological self-reproduction concept of autopoiesis, and takes it over to sociological field. Social systems, as communication systems, reproduce themselves in order to survive. Moreover, social systems are observing systems that even observe themselves. This is the role of sociology (Luhman 1997). This fact links Luhmann's approach not only to second-order cybernetics. In fact it relates Luhmann's sociological theory to the third-order cybernetics field of Sociocybernetics.

Complexity approaches

To address these new sociological way of thinking, our social systems must be approached from the standpoint of the meta-theory of scientific realism of the British philosopher Roy Bhaskar (Bhaskar 1978, 1986) that is not phenomenological, nor positivist, nor reductionist, but holistic. Bhaskar advocates a realist ontology and a scientific critical naturalism that distinguishes the world of nature from the social world. According to Harvey & Reed (1997) a new social scientific world view emerges from this realist ontology of Bhaskar and the complex systems approach, particularly the theory of dissipative systems, giving way to "a dynamic realism… capable of sustaining the particularity and plurality of the social world while preserving rational canons of scientific understanding" (Harvey & Reed 1997, pp297).

Dissipative systems are based on nonequilibrium thermodynamics (Prigogine & Stengers 1984). They are subject to the second law of thermodynamics: the increasing entropy law that drives its dynamic evolution toward a stage of maximum disorder and undifferentiation. However if dissipative systems are open systems, with active interaction with their environment, they may develop negentropic processes through internal metabolic mechanisms to counteract the increasing entropy processes. These mechanisms must take energy from the environment and eliminate positive entropy (waste) giving it away to the immediate environment. In this way dissipative negentropic systems may not only grow but evolve, increasing their internal structural and functional complexity and have a long life in a state far from equilibrium. The evolutionary process begins driving the system to a chaotic bifurcation point, where the system oscillates between two or more atractor points until it settles in a new configuration that depends from the initial conditions.

All biological systems, including man, are evolved dissipative systems. They live so long as their internal metabolic negentropic mechanisms are able to counteract their positive entropic processes.

Dissipative social systems have the same thermodynamic properties and traits that the human beings that produce them. They have evolved from certain initial conditions, through collective internal structuration and external perturbations.

These facts have been the motivation to incorporate the Complex Systems paradigm that has revolutionized physics, chemistry and biology into the analysis of social systems (Wallerstein 1991, Eve, Horsfall & Lee 1997, Kiel & Elliot 1997, Bar-Yam 1997, Byrne 1998, Vester 1999, Marion 1999, Geyer & van der Zouwen 2001, Bar-Yam 2004, Miller & Page 2007, Castellani & Hafferty 2009, Curlee & Gordon 2011). This paradigm includes (Prigogine 1996) the theory of self organizing systems (Kauffman 1993), the theory of complex adaptive systems (Miller & Page 2007), the theory of social networks (Newman, Barabási & Watts 2006), the chaos theory (Lorenz 1993) and the fractal geometry (Mandelbrot 1983).

Social practice theory

Now how can we define an agenda for Sociocybernetics? Before trying to answer this question we must discuss the definition of the social research objects.

Quoting Castellani "sociology is the study of social practice" (Castellani 2009, pp37). This definition is based on a new branch of social theorizing called practice theory, whose principal exponents are Anthony Giddens (1984), Pierre Bourdieu (1990), Michel Foucault (1980) and Brian Castellani (2009). In fact, they conceptualize social reality as social practice, taking social practice as some combination of structure and agency avoiding the dualist sociological discussion between structure and agency. Elaborating on this approach, Castellani (2009) defines social practice as follows: Social practice is any pattern of social organization that emerges out of, and allows for, the intersection of symbolic interaction and social agency. Social practice is the critical concept to define a social system. In fact, for Castellani social complexity theory begins with the assumption that a social system is a type of social practice (Castellani 2009 pp44). This approach coincides with the social systems approach of Luhmann where the referred social practice is communication (Luhmann 1984).

Taking the social practice as the research object of sociology, we may now identify the different types of social practices that are the focus for Sociocybernetics. According to Ritzer (1975, 2000) we may define two dimensions in social analysis: the macroscopic – microscopic and the objective – subjective dimension. Combining these dimensions we define four levels of social practices:

1) The macro – objective level, for instance: practices related to society as a whole, macro-economy, urbanization, industrialization, technological development, governability, etc.
2) The micro-objective level, for instance: practices related to behavioral patterns, social interactions
3) The macro-subjective level, for instance: practices related to culture, social norms, values
4) The micro-subjective level, for instance: practices related to perceptions, beliefs, social construction of reality.

If according to its cybernetical definition the basic task of Sociocybernetics is to understand the guidance and control mechanisms that govern the operation of social practices and to devise better ways of regulating and intervening in them, it is obvious that Sociocybernetics is then the integrated sociological paradigm able to tackle all four levels of social practices.

A framework for sociocybernetics

This is the framework we propose for the development of Sociocybernetics. For this framework we propose to adopt social practice theory (Giddens 1984, Bourdieu 1990, Foucault 1980 and Castellani 2009) as well as social analysis theories based on the interaction of the social systems elements, self-organization processes and social emergence as the new sociological approaches to Sociocybernetics. Among these social theories we may consider the generative social science (Epstein 2006), the social network analysis (Wasserman & Faust 1997, Barabási 2003, Carrington, Scott & Wasserman 2005, Newman, Barabási & Watts 2006, Barrat, Barthélemy & Vespignani 2008, Ganguly, Deutsch & Mukherjee 2009, Barabási 2010), the theory of social structuration (Giddens

1984, Burns & Flam 1987, Archer 1995, Wallerstein 1999), the actualized version of symbolic interactionism (Larossa & Reitzes 1993, Denzin 2007), the complex responsive processes of interaction (Stacey 2001, 2003, 2005), the Luhman's theory of complex social systems (Luhman 1984, 1997, 2002), the computational sociology (Gilbert 2008, Gilbert & Troitzsch 2005, Epstein & Axtell 1996) and the British school of sociology and complexity (Urry 2000, Gilbert 2008, Byrne 1998, Cilliers 1998, Goldspink 2002) .

This sociological framework must be completed by mathematical - computational modeling (Goldspink 2002, Gilbert & Troitzsch 2005), considering that in the social sciences because of ethical and economic reasons it is not feasible to use experimental research on human subjects. Therefore the experimentation must be replaced by computer simulation of social systems. The results of these simulations can generate valuable information for both the theoretical advance of the social sciences and decision analysis in organizations (Morecroft & Sterman 1994, Morecroft 2007). It is therefore necessary to assess the methodological possibilities and limitations of different modeling and computer simulation techniques, as well as analyze the comparative advantages each offers to different types of problems. In this way, the application of computational modeling techniques to social problems must be evaluated. Some of these techniques include agent-based models (Axelrod 1997, Gilbert 2008, Gimm & Railsback 2005, Kohler & Gumerman 2000, Namatame, Terano & Kurumatani 2002, Padgham & Winikoff 2004, Shoham & Leyton-Brown 2009), social network models (Wasserman & Faust 1997, Barabási 2003, Carrington, Scott & Wasserman 2005, Newman, Barabási & Watts 2006, Barrat, Barthélemy & Vespignani 2008, Ganguly, Deutsch & Mukherjee 2009, Barabási 2010), system dynamics models (Forrester 1961, Morecroft & Sterman 1994, Sterman 2000, Morecroft 2007), game theoretic models (Kahneman & Tversky 2000, Camerer 2003, Camerer, Lowenstein & Rabin 2003, Shoham & Leyton-Brown 2009), Petri nets models (Lara-Rosano 1997, 2002), artificial neural networks (Lara-Rosano 1996, Suykens, Vandewalle & De Moor 2010), cross-impact models (Duval, Fontela & Gabus 1974, Bloom 1975, Kaya, Ikishawa & Mori 1979, Lara-Rosano 1995), fuzzy system models (Ragin 1989, Ragin 2000, Smithson 2006, Ragin 2008) and second-moment probabilistic models (Rosenblueth 1975, Lara-Rosano 1981, Sinn 1983, Lara-Rosano 1985) .

Conclusions

In this paper an agenda for Sociocybernetics was presented in order to provide the basis for a meta-methodology of social complexity. We proposed to adopt the complex systems approach as well as social practice and social analysis theories based on the interaction of the social systems elements, self-organization processes and social emergence as the new sociological approach to Sociocybernetics. Moreover this approach must be completed by mathematical-computational modeling and simulation because it is not feasible to use experimental social research on human subjects. The results of these simulations can generate valuable information for both the theoretical advance of the social sciences and pragmatical decision analysis in organizations. It is therefore necessary to assess the methodological possibilities and limitations of different modeling and computer simulation techniques, as well as analyze the comparative advantages each offers to different types of problems. In this way, the application of computational modeling techniques to social problems must be evaluated. Based on these considerations in this paper an agenda for Sociocybernetics was proposed in order to provide the basis for a meta-methodology of social complexity.

References:

- Archer, M.S. 1995. Realist Social Theory: The Morphogenetic Approach. Cambridge: Cambridge University Press.
- Axelrod R. (1997) The Complexity of Cooperation: Agent-Based Models of Competition and Collaboration, Princeton: Princeton University Press.
- Bar – Yam Y. (1997) *Dynamics of Complex Systems*. Boulder: Westview Press.
- Bar – Yam Y. (2004*) Making Things Work*. Cambridge, MA: NECSI Knowledge Press.
- Barabási A L. (2003) Linked: The New Science of Networks. Cambridge, MA: Perseus Publishing.
- Barabási A L. (2010) Bursts: The Hidden Pattern Behind Everything we do. New York: Dutton.

— Barrat A, Barthelemy M & Vespignani A. (2008) Dynamical Processes on Complex Networks. Cambridge: Cambridge University Press.
— Bhaskar, R A. (1978) A Realist Theory of Science, New Jersey: Humanities Press.
— Bhaskar, R A. (1986) Scientific Realism and Human Emancipation, London: Verso.
— Bloom M F. (1975) Deterministic Trend Cross-Impact Forecasting, *Technical Forecasting & Social Change*, 8, pp 35-74.
— Bourdieu P. (1990) The Logic of Practice, Cambridge, England: Polity Press.
— Burns T. R. & H. Flam (1987) The Shaping of Social Organization: Social Rule System Theory with Applications London: Sage.
— Byrne D. (1998) Complexity Theory and the Social Sciences. New York: Routledge.
— Camerer C F. (2003) Behavioral Game Theory: Experiments in Strategic Interaction. Princeton: Princeton University Press.
— Camerer CF, Loewenstein G & Rabin M. (2003) Advances in Behavioral Economics. Princeton: Princeton University Press.
— Canon W B. (1929). Bodily Changes in Pain, Hunger, Fear and Rage. New York: Appleton.
— Carrington P J Scott J & Wasserman S. (2005) Models and Methods in Social Networks Analysis. Cambridge: Cambridge University Press.
— Castellani and Hafferty (2009) Sociology and Complexity Science: A New Field of Inquiry. Berlin: Springer.
— Cilliers P. (1998) Complexity and Postmodernism: Understanding Complex Systems. New York: Routledge.
— Crone J A. (2011) How Can We Solve our Social Problems?, Los Angeles: Sage.
— Curlee W & Gordon R L. (2011) Complexity Theory and Project Management, Hoboken NJ: Wiley.
— Denzin N K. (2007) Symbolic Interactionism and Cultural Studies: The Politics of Interpretation, Oxford: Blackwell.
— Duval A, Fontela E & Gabus A. (1974) Cross-impact: A Handbook on Concepts and Applications. Geneva: Batelle.
— Epstein J M. (2006) Generative social science. Princeton, NJ: Princeton University Press

— Epstein J. M. & Axtell R. (1996) Growing Artificial Societies: Social Science from the Bottom Up. Cambridge MA: MIT Press.
— Eve R A, Horsfall S & Lee M E. (1997) *Chaos, Complexity, and Sociology: myths, models, and theories.* Thousend Oaks, CA: Sage Publications Inc.
— Forrester J W. (1961) Industrial Dynamics, Cambridge, MA: MIT Press.
— Foucault M. (1980) Power/Knowledge: Selected Interviews and Other Writings 1972 – 1977, Gordon C. (ed) New York: Pantheon Books.
— Ganguly N, Deutsch A & Mukherjee A. (2009) Dynamics on and of Complex Networks, Boston: Birkhäuser.
— Geyer F & Van der Zouwen J. (2001) Sociocybernetics: Complexity, Autopoiesis and Observation of Social Systems, London: Greenwood Press.
— Giddens A. (1984) The Constitution of Society: Outline of the Theory of Structuration, Cambridge: Polity Press.
— Gilbert N. (2008) Agent-Based Models, Los Angeles: Sage.
— Gilbert N, Troitzsch K (2005) Simulation for Social Scientists, 2nd Edition. New York, NY: Open University Press
— Goldspink C (2002) Methodological Implications of Complex Systems Approaches to Sociality: Simulation as a Foundation of Knowledge. Journal of Artificial Societies and Social Simulation Vol 5, No 1. http:// jasss.soc.surrey.ac.uk/
— Grimm V & Railsbasck S F. (2005) Individual-based Modeling and Ecology, Princeton: Princeton University Press.
— Harvey D L & Reed M. (1997) Social Science as the Study of Complex Systems in Kiel L D & Elliot E. (eds) *Chaos Theory in the Social Sciences: Foundations and Applications.* Michigan: University of Michigan Press.
— Kahneman D & Tversky A. (2000) Choices, Values and Frames, Cambridge: Cambridge University Press.
— Kauffman, S. A. (1993) *Origins of Order: Selforganization and Selection in Evolution,* Oxford: Oxford University Press.
— Kaya Y, Ikishawa M & Mori S (1979) A Revised Cross-impact Method and its Applications to the Forecast of Urban Transportation Technology, *Technical Forecasting & Social Change*, 14, pp 243 – 257.

- Kiel, L. Douglas & Euel Elliott (eds) (1997) *Chaos Theory in the Social Sciences: foundations and applications*. University of Michigan Press.
- Kohler T A & Gumerman G J. (2000) Dynamics in Human and Primate Societies: Agent-Based Modeling of Social and Spatial Processes, Oxford: Oxford University Press.
- Köhler W. (1920) Die physischen Gestalten in Ruhe und im stationären Zustand: Eine naturphilosophische Untersuchung. Braunschweig: Friedrich Vieweg & Sohn.
- Köhler W. (1927) Zum Problem der Regulation. *Wilhelm Roux's Archiv für Entwicklungsmechanik der Organismen*, No. 112, pp 315-332
- Lara Rosano F. (1981) Prospección de Eventos Interrelacionados mediante segundos momentos, México: Series del Instituto de Ingeniería UNAM, No. 436.
- Lara Rosano F. (1985) Modelado de sistemas complejos mediante segundos momentos, México: Series del Instituto de Ingeniería UNAM, No. 491.
- Lara-Rosano F. (1995) Fuzzy Causal Impact Connectionist Models of Dynamic Systems, *in Advances in Systems Studies Volume II*_G. E. Lasker (ed). Windsor, CANADA: IIAS, (1995), ISBN 0-921836-368 pp 22-26
- Lara-Rosano F. (1996) Fuzzy Causal Modelling of Complex Systems Through Petri Paradigm and Neural Nets, in Advances in Artificial Intelligence and Engineering Cybernetics, Vol. III. G. E. Lasker (ed). Windsor, CANADA: IIAS.
- Lara-Rosano F. (1997) Petri Net Models of Fuzzy Complex Dynamic Systems. In Advances in Cybernetic Modelling of Complex Systems, G.E. Lasker (ed). Windsor, CANADA: IIAS.
- Lara-Rosano F, (2002) Fuzzy Petri Nets as Linguistic Models of Dynamic Systems, in Advances in Artificial Intelligence and Engineering Cybernetics, Vol. VIII. G.E. Lasker (ed). Windsor, CANADA: IIAS
- Larossa R & Reitzes D C. (1993). "Symbolic Interactionism and Family Studies." in Sourcebook of Family Theories and Methods, Boss P G, Doherty W J, Larossa R, Schumm WR & Steinmetz SK. New York: Plenum.
- Lorenz E N. (1993) The Essence of Chaos, Seattle: University of Washington Press.
- Lotka A J. (1925) Elements of Mathematical Biology. New York: Dover (1957).
- Luhmann, N. (1984) Soziale Systeme: Grundriß einer allgemeinen Theorie. Frankfurt:

Suhrkamp
- Luhmann, N. (1997) Die Gesellschaft der Gesellschaft. Frankfurt: Suhrkamp
- Luhmann, N. (2002) Einführung in die Systemtheorie. Frankfurt: Suhrkamp
- Mandelbrot B. (1983) The Fractal Geometry of Nature. New York: Freeman
- Marion, R. (1999) *The Edge of Organization: Chaos and Complexity Theories of Formal Social Systems,* Thousand Oaks, CA: Sage Publications.
- Miller J H & Page S H. (2007) Complex Adaptive Systems: an introduction to computational models of social life. Princeton: Princeton University Press.
- Morecroft J D W & Sterman J D. (1994) Modeling for Learning Organizations, Portland: Productivity Press.
- Morecroft J. (2007) Strategic Modelling and Bussiness Dynamics: a Feedback System Approach. Chichester: Wiley.
- Namatame A, Terano T & Kurumatani K. (2002) Agent-Based Approaches in Economical and Social Complex Systems, Amsterdam: IOS Press.
- Newman M, Barabási A & Watts D J. (eds). (2006) The Structure and Dynamics of Networks. Princeton: Princeton University Press.
- Padgham L & Winikoff M. (2004) Developing Intelligent Agent Systems, Chichester: Wiley
- Prigogine I & Stengers I. (1984) *Order Out of Chaos: Man 's New Dialogue with Nature,* New York: Bantam Books.
- Prigogine I. (1996) The End of Certainty: Time, Chaos and the New Laws of Nature, New York: The Pree Press.
- Ragin C. (1989) The Comparative Method: Moving Beyond Qualitative and Quantitative Strategies. Berkeley: University of California Press.
- Ragin C. (2000) Fuzzy-Set Social Science. Chicago: University of Chicago Press.
- Ragin C. (2008) Redesigning Social Inquiry: Fuzzy Sets and Beyond. Chicago: University of Chicago Press.
- Ritzer G. (1975) Sociology: A Multiple Paradigm Science. Boston: Allyn & Bacon.
- Ritzer G. (2002) Teoría Sociológica Moderna, Madrid: McGraw Hill.
- Rosenblueth E. (1975) Point Estimates for Probability Moments, Proc. National Academy of Sciences, Vol 72, No 10

- Shoham, Y & Leyton-Brown K. (2009) HYPERLINK "http://www.masfoundations.org/" Multiagent Systems: Algorithmic, Game-Theoretic, and Logical Foundations, Cambridge: Cambridge University Press.
- Sinn H W. (1983) Economic Decisions under Uncertainty, second English edition, Amsterdam: North-Holland
- Smithson M. (2006) Fuzzy Set Theory: Applications in the Social Sciences. Thousend Oaks CA: Sage.
- Stacey R D. (2001) Complex Responsive Processes in Organizations. London: Routledge.
- Stacey R D. (2003) Complexity and Group Processes, London: Routledge.
- Stacey R D. (2005) Experiencing Emergence in Organizations: Local Interactions and the Emergence of Global Pattern, London: Routledge.
- Sterman J D. (2000) Business Dynamics: Systems Thinking and Modeling for a Complex World, Boston: McGraw-Hill.
- Suykens J A, Vandewalle J P L & De Moor B L. (2010) Artificial Neural Networks for Modelling and Control of Non-Linear Systems, Berlin: Springer.
- Urry J. (2000) Sociology Beyond Societies, London: Routledge.
- Varela F J & Maturana H R & Uribe R. (1974). Autopoiesis: the organization of living systems, its characterization and a model. *Biosystems* **No 5** 187–196.
- Vester F. (1999) Die Kunst vernetzt zu denken: Ideen und Werkzeuge für einen neuen Umgang mit Komplexität, München: Deutsche Taschenbuch Verlag.
- Von Bertalanffy, L. (1968) *General Systems Theory: Foundations, Development, Applications,* New York: George Braziller.
- Von Foerster H. (1979) Cybernetics of Cybernetics in Krippendorf K. (comp). *Communication and Control in Society*. New York: Gordon & Breach
- Wallerstein I. (1991) Unthinking Social Science: the Limits of Nineteenth-Century paradigms. Cambridge, MA: Polity Press.
- Wallerstein I. (1999) The End of the World as We Know It. Social Science for the XXI Century. Minneapolis: University of Minnessota Press.
- Wasserman S & Faust K. (1997) Social Network Analysis, Cambridge: Cambridge University Press.

— Wiener N & Rosenblueth A. (1948). Cybernetics or control and communication in the animal and the machine. Boston: The Technology Press.