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book of abstracts

Bertalanffy Center for the Study of Systems Science

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EDITORIAL COMMENT
Book of Abstracts EMCSR 2012

We are proud to present the 'Book of Abstracts' for the *21st European Meeting on Cybernetics and Systems Research (EMCSR)*.

Since 1972, the *European Meetings on Cybernetics and Systems Research (EMCSR)* have been held in Austria every two years. They were organised by the *Austrian Society for Cybernetic Studies (OSGK)* founded in 1969 (which established a special institution, the *Austrian Research Institute for Artificial Intelligence (OFAI)*, in 1984, in cooperation with organisations such as the *Department of Medical Cybernetics and Artificial Intelligence*, *University of Vienna*, and the *International Federation for Systems Research (IFSR)*.

The latest meeting was organised by the *Bertalanffy Center for the Study of Systems Science (BCSSS)* in co-operation with a number of other organisations in the field – as the *Austrian Society for Cybernetic Studies* (OSGK), *Hellenic Society for Systemic Studies* (HSSS), *Sociedad Española de Sistemas Generales* (SESGE), *Ukrainian Synergetic Society* (USS), *Union Européenne de Systémique* (UES), *Giordano Bruno GlobalShift University* (GBGU), *The International Academy for Systems and Cybernetic Sciences* (IASCYS*), International Federation for Systems Research* (IFSR), *International Society for the Systems Sciences* (ISSS), *World Organisation of Systems and Cybernetics* (WOSC) – as well as with the help of *B original Business & Communication Design* and the *Austrian Computer Society (OCG)* under the patronage of the *University of Vienna*.

The meeting was open to any researcher in the field, be it systems biology or information systems, complex adaptive systems or sociocybernetics, evolutionary economics or ecosystems research, systems philosophy or constructivism, self-organisation or cognitive science, network theory or artificial intelligence or any other specialisation that is rooted in cybernetics, systems theory or complexity theory - all of them with the potential to endow the subjects of history with guidance and a means for mastering the current transformation.

The meeting focused on the enhancement of the self-reflection of the field in order to provide science with methods, findings and ends to help alleviate the global challenges. Crises multiply and there is a mismatch between what we could do and what needs to be done! Thus the participants of the 21st meeting have been invited to share their insights, and co-create or enhance strategies in complexity, conceptions of complexity and thinking in complexity, involving, among others, questions like the following:

Strategies in complexity

- Do only social systems necessitate the inclusion of the observer? Or does this hold for any system – artificial (see: MERRELYN EMERY) and natural?
- Is the whole of interconnected systems out of human reach? Or can information (technology) reduce the frictions in the functioning of, and in between, those systems (see: ÉRVIN LÁSZLÓ)?
- Is unity-through-diversity only descriptive of a systems architecture? Or is it normative too?

Conception of complexity

- In the conception of emergence is novelty a mere matter of our imagination? Or is it a feature to be ascribed to real-world systems as well?
- Do Agent Based Modelling, networks analysis (see: PÉTER ÉRDI) and modularity suffice to describe self-organisation? Or does a natural system exert downward causation from the structure to its elements, which makes a nested hierarchy different?

Thinking in complexity

- Do formalisms provide the only scientific way of explaining the world? Or can narratives (qualitative methods) contribute to understanding?
- Can we simulate natural systems because the world is a big computer? Or do present-day computers represent a restricted kind of natural dynamics only?
- Can we transfer knowledge between disciplines, learn from, e.g., biology? Or does biology rather exhibit general systemic features that might be detected in social systems as well (see: PÉTER CSERMELY, EDGAR MORIN)?

Futhermore the meeting focused on the social impact different approaches might have because of their different basic assumptions. Thus the submitters were asked to formulate their submission in a way that makes crossing the borders of disciplines, objects of study and schools more easy. The present abstracts may reflect this requirement more or less.

This publication gathers all abstracts that were accepted for presentation at the *21st European Meeting on Cybernetics and Systems Research*. They are abstracts of five keynote speeches, 150 presentations, including 40 invited, at 19 Symposia with different themes, and the PhD Colloquium that were devised by the community and/or the Chair.

Keynotes

- Information and Coherence in Nature and the Cancer of Human-World Incoherence, by Ervin László
- Complex thinking for a complex world – About reductionism, disjunction and systemism, by Edgar Morin
- Crisis responses and crisis management: what can we learn from biological networks? by Péter Csermely
- Forty years in Biocybernetics. Luigi Ricciardi memorial lecture, by Péter Érdi
- Ross Ashby Memorial Lecture: Open or closed systems – Bridging the gap, by Merrelyn Emery

Symposia

- Physical and Metaphysical Aspects of Systems after Morin, chaired by Iryna Dobronravova and Rainer E. Zimmermann
- Evolution Throughout the Sciences and Humanities, chaired by Werner Callebaut, Rudolf Hanel and Manuel Wäckerle
- Systemic Approaches to Regional Disasters chaired by Gerhard Chroust and Nadine Sturm
- Cybernetics of Country Development, chaired by Paul Ballonoff, Tatiana Medvedeva and Stuart Umpleby
- Cybernetics of …: Reciprocity and Reflexivity in Cybernetic Thinking, chaired by Ranulph Glanville and Karl Müller
- Fourth International Symposium on Agent-Based Modeling and Simulation (ABModSim-4), chaired by Stefania Bandini, Paolo Petta and Giuseppe Vizzari
- Observing Luhmann, chaired by Eva Buchinger and Manfred Füllsack
- Professional Systemics, chaired by Nikitas Assimakopoulos and Dimitrios Varsos
- How to Integrate Language, Meaning and Mind with Cybernetic-Systemic Theories of Information?, chaired by Søren Brier
- Urban Systems Research, chaired by J. Alexander Schmidt and Christian Walloth
- Self-* Systems – Biological Foundations and Technological Applications, chaired by Vesna Sesum-Cavic, Wilfried Elmenreich and Carlos Gershenson
- The Past, Present and Future of Cybernetics and Systems Research, chaired by Carlos Gershenson
- Complexity and Management: from the Concept of Innovation to Social Responsibility, chaired by Helena Knyazeva, Matjaz Mulej, Zdenka Zenko, Gerald Steiner, Filippina Risopoulos, Elvis Kenik and Stuart Umpleby
- Dichotomies in Systems Biology, chaired by Joris van Poucke and Veli-Pekka Parkkinen
- Cognitive Relativity, Rationality and Clarity, chaired by Irina Ezhkova

- How to Manage Human Organisations in a Crisis Context. Systemic Theoretical Knowledge Applied to Practical Action, chaired by Guy Koninckx, Claude Lambert, Rafael Lostado Bojó, Alexandre Makarovitsch, Andrée Piecq, Valérie Renault, Maria Sanz, and Anne Steenhout
- Design and Self-Organization in the Emergence of Effective Organizations, chaired by Raul Espejo
- Enabling Organizations for Thrivability: New Perspectives on Form, Structure and Process in favor of Human and Societal Prosperity, chaired by Stefan Blachfellner, Violeta Bulc, Thomas Fundneider and Alexander Laszlo
- Global Crisis: Transitory Exogenous Shock or Unavoidable System Dynamics?, chaired by Manuel Wäckerle

PhD Colloquium & Award

- The organizing committee of the EMCSR 2012 encouraged scientists of pre-doctorate and early post-doctorate stage to present and discuss interdisciplinary research papers within a special Colloquium & Award competing for the Ludwig von Bertalanffy Young Scientist Award, a diploma and money prize, chaired by Peter Fleissner, Pierre Bricage and Alexander Laszlo.

As the meeting was a European one, the abstracts are written primarily by European authors (Austria, Belgium, Denmark, Germany, Finland, France, Greece, Hungary, Latvia, the Netherlands, Norway, Portugal, Russia, Slovenia, Spain, Switzerland, UK, and Ukraine). But we were honored to welcome participants from all regions of the world, like Asia (Georgia, India, Japan), Africa (South Africa), Australia and Americas (Brazil, Columbia, Mexico, USA). Some authors are long-standing attendees of the EMCSR, a considerable number, however, participated for the first time, among them 20 outstanding students of the systems sciences.

These "proceedings" build the basis for the proceedings to follow. All authors are invited to submit full papers by revising their presentations in the light of the discussion at the parallel as well as plenary meetings. Accepted full papers will be published after a rigorous peer review process in the newly established Open Access Journal "Systems" at www.systems-journal.eu.

We hope that this publication is a valuable contribution to the self-reflection of the field of systemics, cybernetics, informatics, evolutionary thinking, complexity, network analysis and other related areas.

About the Editors

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Robert is currently a senior-lecturer in the Department of Communication Studies at the University of Salzburg. Prior, from 2009 to 2011, he was a lecturer at the Shanghai International Studies University (SISU) and from 2004 to 2009 Robert worked as a research fellow and lecturer at the ICT&S Center at the University of Salzburg. Address: University of Salzburg, Department of Communication Studies, Rudolfskai 42, A-5020 Salzburg, Austria. [email: robert.bichler@uti.at]

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Keynotes

Ervin László: *Information and Coherence in Nature and the Cancer of Human-World Incoherence*

Edgar Morin: *Complex Thinking for a Complex World – About Reductionism, Disjunction and Systemism*

Péter Csermely: *Crisis Responses and Crisis Management: What can we Learn from Biological Networks?*

Péter Érdi: *Forty Years in Biocybernetics - Luigi Ricciardi Memorial Lecture*

Merrelyn Emery: *Open or Closed Systems? Bridging the Gap*

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Information and Coherence in Nature and the Cancer of Human-World Incoherence

Ervin Laszlo

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Abstract: *The presence of information in natural systems is not limited to genetic information: all aspects of the functioning of the systems that arise and evolve in nature imply the presence of information (where "information" is used in the sense analogous to that in software systems: it is what codes the behavior of the hardware – in this case, the systems manifest in nature). A key indicator of the presence and adequacy of information in the systems is the coherence discovered within, and between the systems (where "coherence" is intended as the mutual responsiveness of every part of a system in relation to every other part as well as in relation to other systems in the environment).*

Information-based coherence is a sine qua non of the persistence and development of systems in nature. In the biosphere the information present in the systems assures their health and viability. Species operating with imperfect information are less-than-optimally coherent and are ultimately eliminated by natural selection. In the human world, however, incoherence between humans, and between humans and other natural systems is artificially maintained, endangering the overall coherence of the web of life in the biosphere. With the information-bse of contemporary civilization, the human community represents a cancer rather than a positive factor in the web of life. Restoration of adequate levels of coherence in the human world has now become a precondition of thriving, and in the long-term even of surviving, in the biosphere.

Keywords: Information; coherence; incoherence; biosphere; human world

About the Author

Ervin Laszlo

Ervin Laszlo is Founder and President of The Club of Budapest, Chancellor of the Giordano Bruno GlobalShift University, Founder and Director of the General Evolution Research Group, Fellow of the World Academy of Arts and Sciences, Member of the International Academy of Philosophy of Science, Senator of the International Medici Academy, Founding Father of WorldShift, and Editor of the international periodical World Futures: The Journal of General Evolution. He is the author or co-author of fifty-four books translated into as many as twenty-two languages, and the editor of another thirty volumes including a four-volume encyclopedia.

Laszlo has a PhD from the Sorbonne and is the recipient of four honorary PhD's (from the United States, Canada, Finland, and Hungary). He received the Peace Prize of Japan, the Goi Award in Tokyo in 2002, and the International Mandir of Peace Prize in Assisi in 2005. He was nominated for the Nobel Peace Prize in 2004 and was re-nominated in 2005.

Formerly Professor of Philosophy, Systems Science, and Futures Studies in various universities in the US, Europe, and the Far East, Laszlo lectures worldwide. He presently lives in a three hundred year-old converted farmhouse in Tuscany.

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Complex Thinking for a Complex World – About Reductionism, Disjunction and Systemism

Edgar Morin
Philosopher and Sociologist, Paris, France

Abstract: *The following theses will be elaborated on: a) The whole is at the same time more and less than its parts. b) We must abandon the term "object" for systems because all the objects are systems and parts of systems. c) System and organization are the two faces of the same reality. d) Eco-systems illustrate self-organization.*

Keywords: The whole and the parts; system; organization; self-organization

About the Author

Edgar Morin

Born in 1921 in Paris, France. Was director of the CNRS (Centre Nationale de la Recherche Scientifique). His six volumes work La Méthode develops a new weltanschauung, based upon insights in systemics, cybernetics and informatics, ending up in ethics. His most recent publication – The Path to Hope – was written together with Stéphane Hessel (author of "Time for Outrage!").

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Crisis Responses and Crisis Management: What can we Learn from Biological Networks?

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Abstract: *The generality of network properties allows the utilization of the 'wisdom' of biological systems surviving crisis events for many billions of years. Yeast protein-protein interaction network shows a decrease in community-overlap (an increase in community cohesion) in stress. Community rearrangement seems to be a cost-efficient, general crisis-management response of complex systems. Inter-community bridges, such as the highly dynamic 'creative nodes' emerge as crucial determinants helping crisis survival.*

Keywords: adaptation; cellular networks; communication networks; creative node; crisis management; network; network modules; protein-protein interaction networks; social networks; stress; yeast

Acknowledgement: The author thanks members of the LINK-Group (www.linkgroup.hu) for their discussions and help. This work was supported by the EU (TÁMOP-4.2.2/B-10/1-2010-0013) and by the Hungarian Scientific Research Fund (OTKA K-83314).

Biological networks may provide role models of social behavior. In the last decade the network approach became increasingly popular to study complex systems. Current network representations simplify system complexity to a 'one-dimensional' scheme, where the interactions are represented as a connection-weight. Network edges are often directed but, colored graphs, multiple edges, hypergraphs and conditional edges are still seldom used. However, the simplicity of network structures has enormous benefits. They not only give us a visual image of complex systems providing an instant recognition of network communities, hubs and other key nodes, but also have a number of general topological properties, which are very similar in biological, social and engineered networks. The small-world character, the existence of hubs, appearance of network communities and hierarchical, nested structures, the stabilizing role of weak links are all general network features (Csermely, 2009). This allows us to use the network description as a conceptual framework to guide our creative associations.

Network-driven transfer of principal findings allows investigator to judge the importance of her discovery by determining whether the finding is applicable to many types of networks of atoms, molecules, cells or organisms, or is valid to only one of these hierarchical levels. Obviously those findings, which have a general descriptive power to all complex systems, such as those mentioned before, are more important than those, which are highly specific to a certain network. Moreover, the network approach provides a powerful solution to circumvent creativity deadlocks. Networks enable us to translate the original problem in a scientifically rigorous manner into the context of another scientific field, where the same problem is embedded to a quite different conceptual and linguistic context. The novel context often sparks unexpected associations, which lead to creative solutions, when translated back to the original context using the same network-driven approach (Farkas et al, 2011). All these require a multidisciplinary research group, which is quite a commonplace in network science.

One of the authors (P.C.) experienced such a surprising system-based transfer of knowledge from one context to another, when he read the seminal review of Scheffer et al (2009) on the “Early warning signals of critical transitions,” where the authors compared the common signs of pre-crisis periods in ecosystems, markets, and climate. In this review, three major warning signals were identified for all systems studied: 1.) the “slower recovery from perturbations”; 2.) the “increased self-similarity of behavior,” and 3.) the “increased variance of fluctuation patterns.” Based on our earlier studies on aging (Kiss et al, 2009; Simkó et al, 2009), it was imminently clear that an aging organism shows the very same three signs of change. Thus, aging can be perceived as an early warning signal of a critical transition, where the phase transition is called: death. However, this sobering message also has a positive implication: crisis periods can be slowed down, postponed, or prevented by agents of independent and unpredictable behavior, such as stem cells (in organisms), omnivores or top predators (in ecosystems), or market gurus (in markets) (Farkas et al, 2011). Since biological networks are blueprints of organisms, which survived billions of crisis situations, this above examples highlight their great potential as role models of social behavior.

1. Systems level crisis responses of yeast cells

We performed a network analysis of crisis adaptation on the protein-protein interaction network of yeast cells experiencing a severe stress, such as heat shock using our recently developed method (Kovacs et al, 2010). The overlap between communities of the yeast interactome decreased (their cohesion increased), thus the yeast interactome became partially disintegrated as an initial response to stress. The stress-induced decrease of inter-community interactions was beneficial, since it 1.) allowed a better focusing on vital functions, and thus spared resources; 2.) localized damage to the affected communities; 3.) reduced the propagation of noise; 4.) allowed a larger ‘degree of freedom’ of the individual communities to explore different adaptation strategies; and 5.) helped the ‘mediation of inter-community conflicts’ during a period of violent changes (Mihalik & Csermely, 2011).

2. Changes in cohesion and association of network communities – as a general mechanism of crisis management and adaptation

Community reorganization emerged as general and novel systems level way of cost-efficient adaptation (Mihalik & Csermely, 2011). Food limitation causes a diversification and specialization of sea otters (Tinker et al, 2009) that greatly resembles to the changes of yeast protein communities in stress. A similar increase of modularization (patchiness) was observed in increasingly arid environments suffering from a larger and larger drought stress (Rietkerk et al, 2004). A partial decoupling of communities was observed, when criminal networks faced increased prosecution (Kenney, 2009). A recent study detected a reorganization of brain network modules during the learning process (Bassett et al, 2011). Stress-induced psychological dissociation (Bob, 2008) may also be perceived as a partial decoupling of psychological modalities. The stress-induced uncoupling/recoupling cycle greatly resembles Dabrowski’s psychological development theory of positive disintegration (Mendaglio, 2008), as well as the Schumpeterian concept of “creative destruction” describing socio-economic changes (Schumpeter, 1942). In the model of Estrada & Hatano (2010) community overlaps of socio-economic networks were diminished with the increase of external stress (e.g. by social agitation, or crisis). Crisis-induced changes of telephone communication networks were nicely demonstrated by the recent study of Bagrow et al (2011). Increased modularity of the banking system was pointed out by Haldane and May (2011) as a very efficient way to prevent the return and extension of the recent crisis in economy. As we summarized recently (Csermely et al., 2012) networks seem to segregate to two basic conformations, the stratus- and cumulus-like network topology, resembling to the interactome structure of normal and stressed yeast cells, respectively.

Inter-community bridges, such as the highly dynamic ‘creative nodes’ (Csermely, 2008), determine complex systems’ adaptation potential (called evolvability in biological systems). Active centers responsible for the chemical catalysis of enzymes often occupy such a position in protein structure networks (Csermely, 2008). Bridges between communities are reorganized in yeast stress (Mihalik & Csermely, 2011). Inter-community bridges emerge as crucial determinants helping crisis survival.

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About the Author

Peter Csermely

Peter Csermely (53) established the LINK network science group in 2004 (www.linkgroup.hu). In 1995 he launched a highly successful initiative, which provided research opportunities for more than 10,000 gifted high school students so far (www.nyex.info). In 2006 he established the Hungarian National Talent Support Council (www.tehetsegpont.hu) running a talent support network involving ~200,000 people and establishing a Europe-wide network of talent support (www.talentday.eu). He wrote and edited 15 books and published over 200 research papers with total independent citations above 5,200. He was the member of the Wise Persons' Council of the Hungarian President, is a vice president of the Hungarian Biochemical Society is the past president of Cell Stress Society International, an Ashoka Fellow, was a Fogarty and Howard Hughes Scholar and received several other national and international honors and awards including the 2004 Descartes Award of the European Union for Science Communication.

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Forty Years in Biocybernetics - Luigi Ricciardi Memorial Lecture

Péter Érdi

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Abstract: *Luigi M Ricciardi (1942-2011) was a leading figure in biocybernetics, biomathematics and related fields. The lecture reviews some stages of the development in these disciplines in the last forty years by following some stations in his life in terms of some of the positions he hold and conferences he played a major role (Naples, Chicago, Salerno, Vienna, Osaka and Kyoto, Las Palmas etc.) These stages well characterize the transition from the age of the classical cybernetics (in the spirit of Wiener and McCulloch) to the modern theory of neurons and neural networks, and some other fields of biocybernetics and biocomplexity.*

Keywords: Luigi M Ricciardi, Naples, biocybernetics, biomathematics, biocomplexity, neuron, neural network, stochastic model, small worldnetwork, scale-free network

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Luigi Ricciardi

1. From Naples to Naples

"...Professor Caianiello's interests in Cybernetics were indirectly originated by Enrico Fermi who in 1954 strongly supported the setting up of a seminar activity on Computers and on Norbert Wiener's Cybernetics at the University of Rome. In that occasion Professor Caianiello became acquainted with Dr Valentin Braitenberg, a specialist in psychiatry, neurology and neuroanatomy, who eventually joined him at the Institute of Theoretical Physics in Naples and largely co-operated to the setting up of a Division of Cybernetics, sponsored by the Italian National Research Council, with premises in the Institute of Theoretical Physics of Naples University. Dr Braitenberg's role was determinant in focusing Professor Caianiello's interest on the mathematical description of brain activity. It was the beginning of a very happy period for Neapolitan research in Physics, Mathematics and Cybernetics. (LM Ricciardi: Cybernetics and Systems 25 (iii), 1994)

"The photo includes Prof. Ricciardi, Prof. Mimura and his wife at a small piazza of VialeMichelangelo" (courtesy Hiromi Seno)

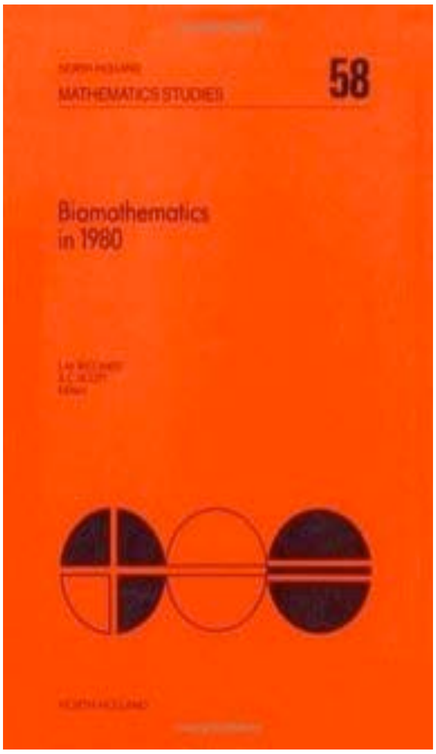
From 1968 until his retirement in 1994, Valentino Braitenberg was director of the department Structure and Function of Natural Nerve-Nets at the Max Planck Institute for Biological Cybernetics in Tűbingen. His research was mainly based on the combination of neuroanatomy with brain theory, with the aim to understand mechanisms of brain functions. Main fields of research were the visual system of the fly, cerebellum and the physiology of movement, and structure and function of the cerebral cortex. Some of his topics on the cerebral cortex were: quantitative-anatomical studies on the cortex of the mouse and on the human cortical white matter, orientation specificity in the visual cortex of primates, connected also with psychophysical studies on humans, as well as a neurological theory of language. (http://www.kyb.tuebingen.mpg.de).

Luigi Ricciardi came to Chicago in 1969 as Assistant Professor of Mathematical Biology. At that time, the Committee on Mathematical Biology was being expanded and was expected to morph into the Department of Theoretical Biology. Luigi was among a group of young new assistant professors who went on to distinguished careers. In this group, there were such names as Art Winfree, Stuart Kauffman, and Montgomery Slatkin. They joined a group that included such established professors as Jack Cowan, Dick Levins, and Richard Lewontin, as well as recent recruits who were already well-known in other fields, such as Stuart Rice and Morrel Cohen. There was also a distinguished roster of visitors, including Warren McCulloch, Michael Arbib, E. O.Wilson, Rene Thom, and Eduardo Caianiello. At that time, neural nets were a hot topic. McCulloch, who had invented neural nets 25 years earlier, was still active and he had a number of students working in that area. Stu Kauffman had recently shown that related Boolean models could also be used to describe genetic systems. Since Luigi had worked on neural nets with Caianiello and DeLuca, it seemed natural that he should supervise my thesis on neural nets. My thesis showed that techniques from linear algebra could be used to study neural nets if they were consideredas polynomials over finite fields rather than as linear threshold devices. I successfully defended my thesis in June 1970 with Luigi as my major professor and Prof. Caianiello as a member of my committee." (Paul Cull: Mathematical Biology in Chicago)

Remembrances of Luigi in Chicago by Paul Cull, Oregon State University, USA

"I had the pleasure of meeting Luigi at the (first) European Meeting on Cybernetics and Systems Research in Vienna in 1972 where he organised and chaired a symposium on "Biocybernetics and Theoretical Biology". It was such a success that I invited Luigi to organise and chair a symposium also at the next Meeting in 1974 and then again at all the following biannual meetings until 2010 when I met him for the last time. The symposia organised by him usually attracted the largest number of contributors with high-quality presentations. (Robert Trappl)."

2. Biomathematics and Biocybernetics

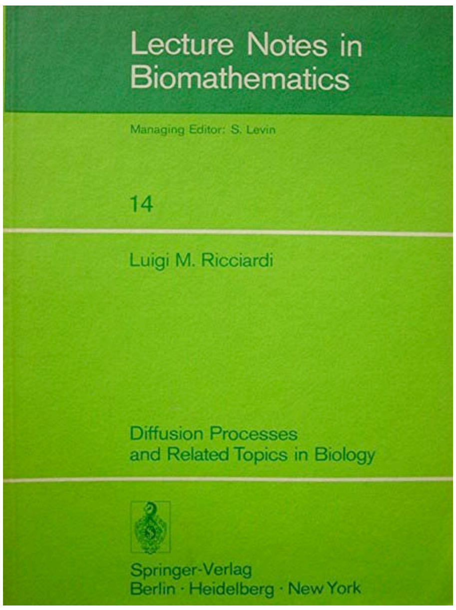


Among others:

R Rosen: Feedforward control and senescence
H Haken: Mathematical methods of synergetics for applications to self-organizing systems
AV Holden: The mathematics of excitation
V. Braitenberg: Outline of a theory of the cerebral cortex
G. Palm: How useful are associative memories?
S Amari: A mathematical theory of self-organizing systems
E Labos: Eective extraction of information included in network descriptions and neural spike records
Radil-Weiss, T: Human visual perception and recognition

A.G. Nobile, L.M. Ricciardi and L. Sacerdote: On a class of dierence equations modeling growth processes

A very important conference organized by Luigi in Salerno (1980).



3. Neural Network - Stochastic Models

Membrane potential as a Brownian particle: continuous time continuous state space stochastic

$$\mathrm{d}X(t) = \mu[X(t), t]\mathrm{d}t + \sigma[X(t), t]\mathrm{d}W(t) \tag{1}$$

$$T = \inf_{t \geq t_0} \{t : X(t) > S(t) | X(t_0) = x_0\} \tag{2}$$

$$g[S(t), t | x_0, t_0] = \frac{\partial}{\partial t} P\{T \leq t\} \tag{3}$$

process (diffusion process).

First Passage Problem: When the voltage at a particular place on a neuron reaches a threshold, an action potential (nerve impulse) is produced. Many point processes in biology have similar origins as "first passage times"; that is, they occur when some underlying process first reaches a critical level or threshold.

Luigi with Henry Tuckwell and Hugh Wilson

Even for simple models of the underlying process (1-dimensional stochastic differential equations), very few analytical results are available for first passage times. Through simulation and heuristic approximation methods, several different types of behavior have been identified. The main current research activities are further development of approximation methods.

4. Neural Networks

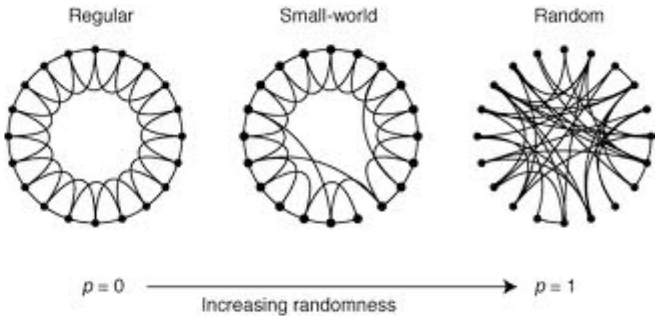
Determinism versus randomness: János Szentágothai (1912-1994)

Michael Arbib, János Szentágothai, Luigi Ricciardi (Capri, 1992: Int. School on Neural modeling and neural networks, organized by Francesco Ventriglia)

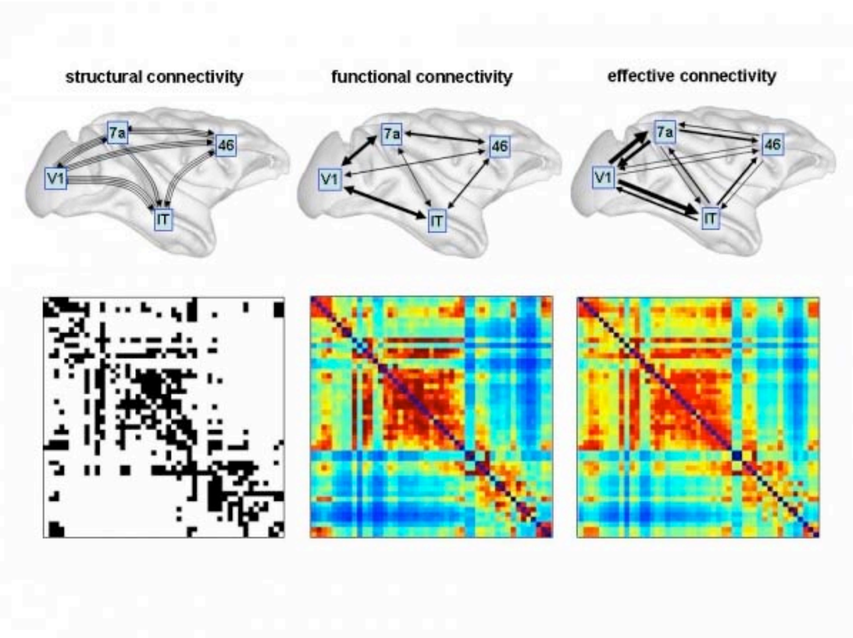
4.1. Small world and scale-free networks?

1. The nervous system of the nematoda worm *Caeneorhabditis elegans* forms a small-world network.
2. Mammalian cerebral cortex: its network is neither regular nor random.
3. The distance of two arbitrarily chosen cortical neurons is 5 . (John Szentágothai)

1. **Anatomical connectivity:** the set of synaptic connections linking its elements
2. **Functional connectivity:** the correlations between spatially remote neurophysiological events.
3. **Effective connectivity:** the influence a neuron (or neuronal population) on another. At the neuronal level this is equivalent to the effect pre-synaptic activity has on post-synaptic responses, otherwise known as synaptic efficacy. Models of effective connectivity are designed to identify a suitable metric of influence among interconnected components (or regions of interest) in the brain.



4.2. Brain Connectivity



Modes of brain connectivity. Sketches at the top illustrate structural connectivity (fiber pathways), functional connectivity (correlations), and effective connectivity (information flow) among four brain regions in macaque cortex. Matrices at the bottom show binary structural connections (left), symmetric mutual information (middle) and non-symmetric transfer entropy (right). Data was obtained from a large-scale simulation of cortical dynamics … (Olaf Sporns: http://www.scholarpedia.org/article/Brain Connectivity)

About the Author

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Open or Closed Systems? Bridging the Gap

Merrelyn Emery

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Abstract: *It is an honour to deliver the Ashby Lecture, a memorial to a great man and a great mind. Open Systems Theory (OST) is one of the approaches to social science that includes Ashby's work amongst its foundations. However despite its solid foundations, OST seems to have become almost invisible since Fred Emery returned to Australia in 1969. Up until that time, it was well known in the Northern hemisphere, certainly Emery & Trist's 1965 citation classic was well known, as was also just as certainly that subsection of OST concerned with the development of jointly optimized sociotechnical systems.*

The reasons for this period of relative invisibility don't matter but as OST has made huge strides since 1969, it seems a shame that such solidly based and reliably successful developments are not widely known to today's international systems community. I hope to start building a bridge across that current knowledge gap.

In overview, this paper firstly outlines the major developments of the OST conceptual framework from its misty historical origins to today. It discusses the basic purpose of OST and how that purpose is embedded in its methods. Finally, it describes the asymmetrical nature of the open and closed conceptualizations and proposes a logical way forward, not only to bridge what is seen as a conceptual gap but also to radically accelerate our practical progress towards active adaptation.

1. Following a chronology of the major developments since the definitive break with closed systems in 1965, the paper describes the current state of the OST art and science. OST adheres strictly to the conventions and methods of science: the art lies in the understanding, skill and human qualities, such as humour, with which it is practiced in the field. The paper describes the foundations on which OST is based, its definitions of system and the social environments within which humans behave and change, its definition of people and their various potentials in terms of ideal-seeking, learning and consciousness, its conceptualization of 'organization' in terms of the genotypical design principles of organizational structures and how we use their implications for decisions about what is ethical scientific research.

2. The development of OST is grounded in the world hypothesis of contextualism and it contrasts starkly with the world hypothesis of mechanism which dominated the history of the planet from about 1793-1950, landing us in the pickle we are in today with accelerating climate change. Since 1950 we have been struggling with a social field characterized by relevant uncertainty, the source of now galloping maladaptions, both active and passive. OST's purpose, framed by this changing causal texture of the social field is the taming or domestication of this field, to be achieved by a return to active adaptation throughout society, to a modern form of the adaptive social field that our ancient cultures maintained for at least 60,000 years.

Understanding OST in this long term context explicates the purposes of the three major methods developed from that framework. The results of these methods, both in terms of practical systems on the ground and empirical data to inform planning, policy making and future research, are promising. It is important that we diffuse OST as rapidly as possible given the similarly rapidly closing time frame in which to cease CO2 emissions. The Occupy movement needs OST methods right now.

3. Bridging the gap between open and closed systems entails a simple logic leading to a proposition. Whether we look at the relations of the world hypotheses behind these formulations, contextualism for open systems and formism, mechanism or organicism for closed, or the relations between open and closed themselves, we see that the relations are inherently asymmetrical. Contextualism and open systems do not preclude the use of other world hypotheses or closed systems analyses but starting with the use of formism, mechanism or organicism or the assumption of a closed system precludes the possibility of contextualism and an open system.

It is clear, therefore, that the concept of an open system has primacy in terms of a comprehensive social science and consequent enhanced understanding of the human and social world. In so far as open systems are rooted in synthesis and closed systems in analysis, synthesis covers the synthesis of analyses and the synthesis of levels of synthesis and analysis. This is not a play on words: in any major piece of research, there is always the possibility of different dimensions of the project being approached with synthetic and analytic methods and integrated into an overall synthesis.

Brief examples from the fields of organizational democratization and community planning for the mitigation of, and adaptation to, climate change illustrate the point. There is no need for a gap in practice any more than there is a need for an either/or distinction between open and closed at the conceptual level.

Keywords: democratization; genotypical design principles; open systems; social environment; socioecology; sociotechnical systems; synthesis

About the Author

Merrelyn Emery

Merrelyn Emery obtained her first class honours degree in psychology from the University of New England in 1964 and her PhD in marketing from the University of New South Wales in 1986, which was actually about the neurophysiological effects of television. She has worked in psychology, education research and continuing education, mainly at the Australian National University. Since 1970 she has worked specifically to develop open systems theory and is currently an adjunct professor in Applied Human Sciences at Concordia University. She has published numerous articles together with a host of institutional research reports as well as 15 books, the latest of which is The Future of Schools. She has just finished a monograph on the latest wave of social change, which started in Tunisia and is still developing through Syria and the Occupy movement.

In the short term, she is working on the development of an ‘at risk’ test for mental illness based on the affects, which can be used in normal populations in organizations. This is part of the overall effort to combat the global epidemic of depression and to restore people to health in innovative, productive organizations through democratization. In the longer term, she has two research projects. The first of these involves research and the development of practical strategies for organizations and communities to more effectively address the cause and effects of climate change. The second will result in a book documenting the need for science in general to move from closed system frameworks and reductionism to acknowledging the reality of our world and our people as open systems.

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PhD Colloquium

Andreas Hieronymi: *The Integration Challenge for the Systems Sciences: Highlighting Internal and External Interconnections*

Florian Waldner: *Developing an Agent-based Model of Markets for Digital Cultural Goods*

Georg Weichhart: *Applied e-Learning Systems Research – A Empirical, Qualitative Method for Modelling e-Learning Environments*

Jessica Foley: *Exploring the 'Transdisciplinary': A Contiguous Analysis via a Russian Futurist Poet and von Bertalanffy's General Systems Theory*

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The Integration Challenge for the Systems Sciences: Highlighting Internal and External Interconnections

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Abstract: *Systems science is concerned, among other things, with functional wholes, interactive parts and exchange with the systems environment. What does it mean to observe systems science itself with respect to these aspects? What function does systems science have within the landscape of sciences? What do the various systemic sub-disciplines contribute to a united systems science?*

In this paper we will attempt the following:

- Indicating a set of interrelated system principles. Using this set to clarify the special characteristics and contributions of the sub-disciplines of systems science.

- Localizing systems science within the landscape of sciences and indicating relevant connections.

Keywords: systems science; philosophy of science; interdisciplinarity; maps, sub-disciplines; system principles; system types; system classes; systems thinking; systems thinkers

About the Author

Andreas Hieronymi

Andreas Hieronymi is a PhD student at the University of St. Gallen and is working as a consultant and project leader at DIACOVA, a Swiss company in the field of human resource development. He has a major in organizational psychology, as well as a background in philosophy of science and computer science.

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Developing an Agent-based Model of Markets for Digital Cultural Goods

Florian Waldner

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Abstract: *In the last decade it has become clear that the Internet will play an ever greater role in the distribution of cultural contents. Mobile devices, designed to store and give digital access to contents such as news, books, music, or video, made digital contents reachable by a large number of consumers. This digitalization supports the natural impulse to forward interesting content to friends better than any other analog format before. The opportunities for self-presentation within social networking internet sites are becoming key factors in the distribution of cultural goods. It is evident that in digital social networks, word-of-mouth can significantly impact the consumption decisions.*

So far incumbent companies in the cultural industries (e.g. the remaining major record labels) had severe difficulties in adequately reacting to these changes. How does one capture value from delivering digital files, which users expect to download for free? This is a fundamental challenge many companies in the cultural industry currently face. The traditional business models are in crisis and it is not yet clear what potential new business models will look like. In this situation, experiments with alternative business models are essential to identify new approaches and create the data necessary to justify them (Chesbrough, 2010).

By developing an agent-based model of markets for digital cultural goods the author aims at evaluating what-if questions without cost and time of real world experiments. The model is used to analyze dynamics of consumer decisions in alternative business models. Based on the model proposed by Epstein and Axtell (1996) agents are given internal states to represent cultural factors and augment their behavioral repertoire with simple local rules for cultural interchange. The model consists of a population of agents that produce, consume, and talk about cultural goods.

Markets for digital cultural goods are markets that coordinate as complex social networks where consumption and production decisions are influenced by information feedback over social networks (Potts et al., 2008). The main benefit of this definition is that it allows using analytic models, in particular those of network and complexity theory (Watts and Strogatz 1998). The standard model in the economic theory of consumer demand assumes fully rational agents with fixed individual preferences. On markets for cultural goods, where tastes and preferences necessarily evolve, these assumptions seem to be inappropriate (Ormerod and Bentley 2010). In contrast, agents in this model use the decisions of others as a basis for their own decisions (Bentley et al., 2007).

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About the Author

Florian Waldner

Florian Waldner is currently scientific assistant and PhD candidate at the University of Vienna in the area of Innovation and Technology Management. He is interested in agent-based modeling and markets for cultural goods, particularly the market for recorded music. He has been working in the field of interactive music with a London based music-technology startup

(Reality Jockey Ltd.). Before joining Reality Jockey Ltd he worked in the field of conceptual modeling at the Department Knowledge Engineering at the University of Vienna. He received a master's degree in International Business Administration at the University of Vienna and a master's degree in Digital Art at the University of Applied Arts Vienna.

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Applied e-Learning Systems Research

A Empirical, Qualitative Method for Modelling e-Learning Environments

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Abstract: *To research learning environments requires insight in a complex system. Building an e-learning environment requires to transfer these insights into a formal model. We developed a method that bridges the gap between empirical qualitative approaches and software engineering. The method combines experts-interviews, concept mapping, and communicative validation. It has been developed and applied in the context of engineering an e-learning support environment for the Dalton-Plan pedagogics.*

Keywords: progressive education; Dalton-Plan; e-learning; systems engineering

1. Introduction

Learning is researched from multiple domains. This results in heterogeneous views and approaches to research. Bridging domains requires to understand multiple world views and research methods.

This paper presents an empirical, qualitative study on the implementation of assignments in general and Dalton-Plan assignments in particular within "e-learning environments". First a novel qualitative method has been created to combine aspects of qualitative, empirical research and software requirements engineering. The description of the method is followed by a presentation and discussion of the research results.

2. Progressive Education and the Dalton-Plan

Progressive education (Skiera, 2004) stands in contrast to teacher-centred traditional forms of education. While different progressive education approaches have different principles and methods, many of them share the following principles:

- individual learning strategies and self-organised learning
- knowledge construction in groups
- situated, complex, real problems to solve
- teachers provide a positive learn environment

There is growing evidence that teaching based on these principles does work (Michael, 2006). These principles are also in-line with constructivist approaches to education (cf. Reich 2008).

e-Learning as a method is capable of supporting these principles (Auinger & Stary 2005). The research work at hand, aims at providing an e-Learning environment supporting a particular progressive education approach, the Dalton-Plan (Parkhurst, 1924). The Dalton-Plan places emphasis on two instruments, assignments and progress-graphs. Assignments bring together several aspects, which aim at supporting learners in their own self-organisation of learning tasks. The following figure brings together the different aspects and their interdependencies.

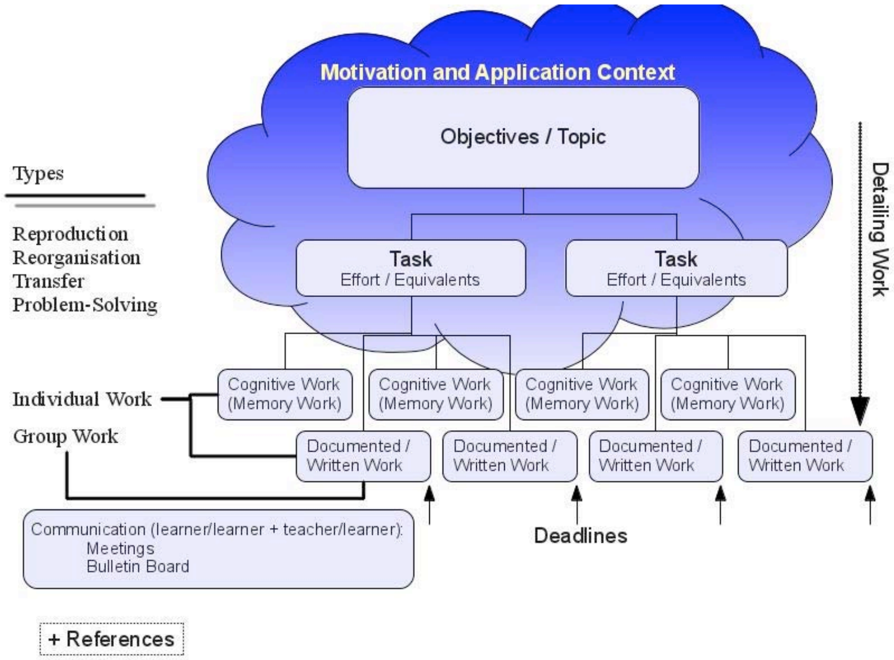

Figure 1: Aggregation of Sections in Dalton-Plan Assignments

The motivation section of the addresses the stage of capacity building the assignment should be used and what learners can expect when accomplishing the tasks. The objectives set the scope in terms of the topics that are addressed and the understanding that should result from exploring and processing learning content. The task section should contain different types of learning tasks, addressing different learning styles (ie. tasks ranging from reproduction tasks to problem-solving tasks). The work section comprises a documented and an intellectual work part. It encourages active information search and exploration, communication, and personality development. The conference section sets dates and content for virtual and face-to-face meetings of the addressed learning community. The reference section provides links and literature that could help to accomplish the tasks. The bulletins can be dynamically created and are available in the online info board. Finally, the equivalents reveal the estimated individual effort for learners to meet the objectives.

Below a concept map[1] is shown, which shows the expert's view on assignments and the structure and principles included in assignments.

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[1] A concept map is composed of two element types: concepts and propositions. A proposition is a concept with a named association and a second concept.

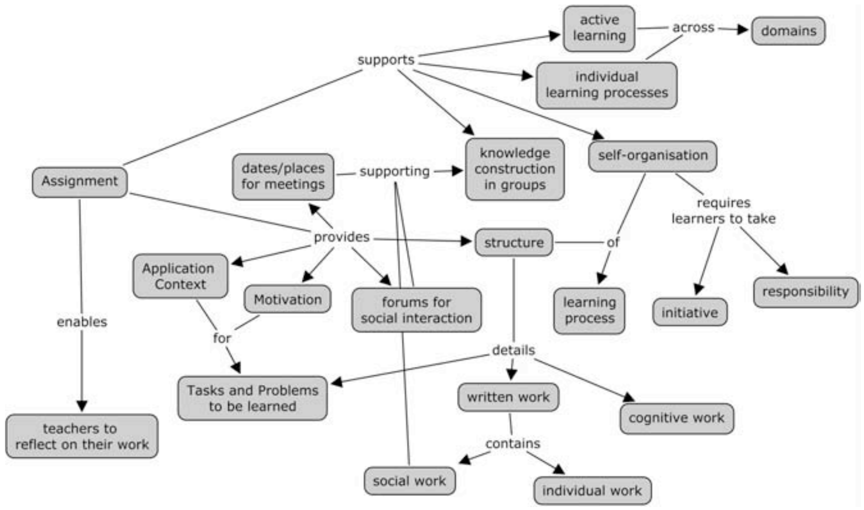

Figure 2: Expert's view on assignments

Assignments in progressive education are used to support active, self-organised learning. Learning is done individually and in groups. Assignments present the structure of the work to be done by learners in advance. However the assignments should be motivated by real-world application contexts. Learning tasks, where documents are produced (ie. tasks in the written/documented work section) need to guide the learning process but keep the result open. Assignments need to make it clear that its the learner's responsibility for the outcome.

To be able to monitor and guide the process, interactions between learners themselves and between learners and the teacher are planed in the conferences section. This includes for example meetings for which learners prepare preliminary results and present it to a group.

3. Qualitative Research

Due to limited research work in this particular domain there is a need to gain insights about requirements and features an e-Learning environment needs to address. Empirical research is necessary. In a first step it is necessary to understand the basic teaching principles and features used by experienced teachers. Empirical research methods are a means to get this understanding. However, since the overall research aims at building a novel solution to support teachers, only *describing* the views of experts is too limited. The results need to be transferred into a form that helps to engineer a support system .A method is needed to pinpoint the core concepts (e.g. features, methods) and their relationships, in order to inform the design of the e-learning environment.

The research method needs to support to reconstruction of knowledge by experts in the field. Explorative expert interviews are a qualitative empirical method that enables getting an initial understanding of a domain (Mayring 2002). To structure the interviews, we created a guiding list of questions. The taped interviews were expected to contain very rich descriptions and complex interdependencies between concepts. To build an informative abstraction of the interview's content, we have been evaluating methods allowing to model the experts world view, and which are easy to comprehend, so experts are able to validate the models. Graphical modelling methods aim at providing such abstractions. Taking a look at multiple methods we have identified “concept mapping” (Novak and Cañas, 2008) as the best approach to reach this goal.

We constructed concept maps from the interviews following the approach of Noval and Cañas (2008) using the CMap tool. Each concept map was presented to the expert in order to validate it using the communicative validation approach.

In a final step, parts of the three maps, showing similar topics, have been combined. One example of such combination is shown in Fig. 2.

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Georg Weichhart is researcher at the Business Information Systems / Communications Engineering department of Johannes Kepler University Linz. He received his masters degree at Vienna University in 1998. He worked as an engineer at a private software company and as project manager at a private research institute. He has been participating as researcher and software architect in numerous European research projects. His current research interest is e-learning support for Dalton Plan Education.

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Exploring the 'Transdisciplinary': A Contiguous Analysis via a Russian Futurist Poet and von Bertalanffy's General Systems Theory

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Abstract: *This paper presents a contiguous analysis of 'transdisciplinary' praxis, von Bertallanffy's General System Theory and the experimental poetic & linguistic work of the Poet Velimir Khlebnikov. These examples act as a foil for an auto-communicative consideration of an emergent PhD thesis from the context of a telecommunications research centre.*

Keywords: transdisciplinary; Poetry; art; telecommunications engineering; science; General Systems Theory; Ludwig von Bertallanfy; Velimir Khlebnikov; Russian Futurism

Acknowledgement: This research is supported by the Science Foundation Ireland, CTVR/the centre for Telecommunications Research, and Trinity College Dublin.

About the Author

Jessica Foley

I hold a B.Design in Visual Communication, a H.Dip in Art & Design Education, and an M.A. in Contemporary Art Practices and Theory. I have taught widely throughout the Irish Education System, from Primary to 3rd level and Adult Education. I work professionally as an artist and researcher. My work involves writing, image making and collaborative activities with individuals & groups. I make responses to environments & situations in which I find myself, or place myself, allowing these responses to echo off into imagined places, weaving narratives and thoughts, often through a kind of poetry, in an effort to explore and understand time, space & experience, systems & technologies.

Mostly, I am an essayist attempting to formulate a science of essay. I am trying to find ways to encourage open (phatic) communication across boundaries whether perceived or invented. (The boundary could be institutional, political, aesthetic, personal, historical, etc.)

I am currently a first year PhD candidate at Trinity College Dublin, working out of CTVR, a Telecommunications Research Centre. My PhD project is concerned with the emergence of transdisciplinary praxes and the discourse associated with this emergence, particularly within Art, Technology, Engineering and Science.

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european meetings on cybernetics and systems research

Symposium A. Physical and Metaphysical Aspects of Systems after Morin

Chairs: Iryna Dobronravova, Kiev National Shevchenko University, Kiev, Ukraine, and Rainer E. Zimmermann, Munich University of Applied Sciences, Munich, Germany, and Clare Hall, University of Cambridge, UK

In a fashion of a strictly cross-disciplinary composition, the symposium shall provide and discuss insight into the state of the theory of evolutionary systems reflecting the consequences of Morin's all-encompassing approach with a view to various other fields of development in the philosophy, sciences and arts. Primarily, it shall be demonstrated that a large amount of research activities in these fields tend to converge to a common viewpoint under the perspective of a universal concept of system which is intrinsic to conceptualizations starting with the pre-Socratic philosophers and ending in our days with modern approaches to emergent complex systems. On the one hand, the meditative triad of cognition, communication, and co-operation is being stressed, on the other hand, the epistemic triad of space, network, and system turns out to be relevant. It will be shown that it is in particular the conceptual parallelism between energy-matter and information-structure which serves as adequate metaphysical basis underlying the discussion of physical aspects of the observable worldly.

Inga R. Gammel: *Aspects of Greek Natural Philosophy – With Focus on the Cosmology of Empedocles*

Iryna Dobronravova: *Complexity as a Process*

Cecile Malaspina: *Complexity and Epistemological Noise*

Vijak Haddadi Moghaddam: *Is a Metaphysics of the System Possible Again?*

Laszlo Ropolyi: *Systems vs. Networks – A Philosophical Reconsideration*

Iurii Mielkov: *Human-commensurable Systems: from Complexity to Harmony*

Elodie Vieille Blanchard: *The global System in Jeopardy of Collapse: the Club of Rome, Systems Sciences and the Limits to Growth Report*

Natalia Kochubey: *Childhood as Complexity*

Iryna Predborska: *Paradigm of Homo Complexus as a Challenge to the Contemporary Education*

Lyudmila Gorbunova: *Transversality of Complex Thinking*

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Aspects of Greek Natural Philosophy

With Focus on the Cosmology of Empedocles

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Abstract: *Contemporary cosmology is by far superior to the theories established by the Greek natural philosophers. So why take any interest in ancient cosmology, one could ask? To be frank, do these reflections handed down to us comprise more than just fancy caprice, aesthetic images, and poetic language? In my paper I should like to address these questions with special focus on the cosmology of Empedocles.*

Empedocles' speculative cosmology is a theory of how a natural self-organizing system works. It is a system that eternally shifts between becoming and decaying, evolution and devolution, creation and annihilation. But according to Empedocles, all stages in this eternally ongoing process are features of life, and, as such life can never exhaust itself. To illuminate the character of Empedocles' cosmology I shall launch a brief narrative of his system followed by a discussion of the aesthetic images and mental pictures that make up the foundation of it. Finally, I shall touch on the subtle question if such a speculative and semi-poetic attitude might be of any significance to contemporary cosmology, and to the sciences in general.

Keywords: cosmology; Greek natural philosophers; empedocles

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Complexity as a Process

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Abstract: *An extended abstract for the proposed report at the symposium deals with methodological aspects of consideration the complexity as a process. It is showed importance of ideas of L. v Bertalanfy, H.Haken, E.Morin for elaboration of adequate approach to understand complexity so as to use the opportunity if classical dialectic thinking.*

Keywords: complexity; dialectic; process; self-organization

It seems the formulation of the title means rather ontological aspect of consideration. That is representation of complexity in the scientific world picture. Those are processes of cooperative movement of medium elements both in limit cycles of dissipative structures and in nonlinear chaotic dynamic of fractals.

But as a world picture is the scientific one, to enter description of a subject without the adequate method is impossible. And the method here needs to be understood widely enough, as the methodological consciousness armed with knowledge not only rules of a method, but also conditions of its application, and the philosophical foundations of its understanding. Otherwise helpful "self-evident", inspired by the previous methodology, will change question statement, having excluded very possibility of the answer adequate to a new situation.

It just takes place to be in understanding of complexity where the question on of what the complex system consists is typical. This understanding the complexity as the combined of elements is directly connected with a reduction principle, reducing complexity to the simple. This principle perfectly worked in a linear science, especially in physics and in chemistry, last three hundred years. First simple mechanical representations was based it, but later a reduction principle was supported by the respectable system approach. L. Bertalanfy's works were directed on transforming of the system approach to make it adequate to complexity of the alive/ They were accepted in biology and cybernetics, but have changed a little in the physics and even in biophysics till becoming of nonlinear science.

Self-organization in nonlinear media can be understood as a becoming of a system as a whole when cooperative behavior of medium elements creates the whole and properties of parts are defined by properties of the whole, rather the reverse. To such understanding of becoming and reproduction of complex systems the slaving principle, entered by the founder of synergetics Herman Haken, is methodologically adequate. This principle is completely opposite to a reduction principle. The word "process" here is a key. To understand something as a complex whole, which is non reducible to combination of its elements, it is possible only regarding it in process of becoming or of periodical processes of its reproducing. The self-organizing whole creates to itself the parts from elements of medium in the course of the becoming.

So to understand a complex system as a whole we need to use dialectical thinking. Edgar Morin shows it is not enough for understanding the all aspects of complexity. He warned about other different ways of reductionism in linear thinking: cybernetic reductionism, digital reductionism. To avoid such reductionism we must develop the classical dialectic thinking in so called dialogical way. It means the foundations of complexity thinking must become wider. Thus, for example, Morin considers causality as complex causality. Such consideration must include the final causality, cyclic causality, correlation between endo- and exo- causality and generative capability. However, on my view, Morin underestimates the opportunities of classical dialectic thinking in this case. I mean the possibility to regard the bifurcation points as situations of efficient cause formation (Dobronravova, 1997), using Hegelian terms from the second part of “Science of Logic” to understand the processes of self-organization. Such interpretation allows us to avoid the paradox statements like “small causes make large effects”.

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Complexity and Epistemological Noise

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Abstract: *[…] 'ambiguity, uncertainty, noise, errors'* (Morin, 39)*. Systems theory, and the study of complex systems in particular, is a relatively young science. Scientific credibility, however, is slow to establish itself outside the jurisdiction of determinism. It may require a leap of faith, therefore, to regard complex systems theories not only as fundamental to the theory of knowledge, but to turn the vague notion of noise into a fundamental epistemological concept. The current transformation of systems theories requires the concept of noise as counter balance to the return of a great philosophical theme: the idea of a 'system of systems'. The current call for trans- or meta-systemic thinking veers towards the idea of a 'science of sciences' or a 'network of networks'.Taking Schelling's concept of 'Ungrund' as an analogon to the concept of noise will help us to withstand the totalising shadow that has historically accompanied the most ambitious systemic thinkers. The purpose of this presentation is to introduce the concept of noise between the innumerable specializations in the natural and human sciences. The porosity of disciplinary limits, translational lacunas and inter-disciplinary tensions are factors of 'epistemic' noise. Leaning on Edgar Morin's definition of noise in 'eco-communication', we will regard noise not only as factor of 'complexity, sophistication and subtlety', but as precondition for communication, as 'ground' for information. 'Today', writes the philosopher and bio-physicist Henri Atlan in 1979, such ideas are 'presented as self-evident, that is to say that the creation of information can only occur on the basis of noise'.*

Keywords: systems; complexity; noise; French epistemology; Schelling; interdisciplinarity; transdisciplinarity

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Is a Metaphysics of the System Possible Again?

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Abstract: *The system is dead, long live the system – such or suchlike is the credo of general intellectual culture after the oft-invoked demise of the philosophies of the system, most notably the grand systems of the absolute of German Idealism. For while the integration of all knowledge into a comprehensive system of thought seems to be thoroughly discredited as pretentious impossibility, we witness the proliferation of a wide range of most fruitful theoretic endeavours that emphasise the systematicity of all spheres of reality. Yet, many of these research programs in the new systemics very deliberately limit their scope and ambits to that of epistemological heuristics and seek to eschew any metaphysical commitments. Perhaps the most carefully argued of these positions is to be found in the radical constructivism of von Glasersfeld and von Foerster, who present systems theory as anti-metaphysical epistemology in the spirit of Kant and Wittgenstein. My paper is based on the premiss that the excessive epistemic humility of radical constructivism has become counter-productive in an age which presents complex problems that need treatment by a more assertive general systems science and philosophy. To this end, I will argue that a line of thought similar to that which allowed the German Idealist thinkers to go beyond the Kantian epistemological limitations and instead unto a position which can be called onto-epistemological, can be deployed today against radical constructivism in order to expose theoretical inadequacies which result from epistemologistic restrictions of systems theory, and can moreover be used to reach the necessary metaphysical propositions in order to overcome these inadequacies. I will enforce my argument for a systems metaphysics by integrating it with an anti-Wittgensteinian reading of Spencer-Brown's calculus of indications as proto-ontology of systems. In the final analysis, I will argue that while the systems metaphysics of German Idealism presented what we can call a monosystemic cosmology in which all of reality was integrated into the one comprehensive system of the absolute, the new systems metaphysics based on the rejection of epistemologism and the integration of the multitude of systems as discerned by modern systems theory into a holographic metaphysical scheme, will of necessity figure as what I term a polysystemic cosmology in which reality is presented as an infinity of interconnected, yet autonomous and autological, systems.*

Keywords: systems philosophy; epistemology; metaphysics; cybernetics; German Idealism; radical constructivism

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Vijak is a systems philosopher who holds academic degrees in political economy and international relations and is currently completing a PhD in philosophy in London.. He has been active as an advisor to various projects, including an experiment in social design funded by the Haus der Kulturen der Welt in Berlin. His main aim of theoretical investigation, situated at the interstices of philosophy and systems theory, lies in discerning and articulating the abstract logic of systems across the various layers of reality from the cosmological to the social and the existential.

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Systems vs. Networks – A Philosophical Reconsideration

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Abstract: *Based on a detailed philosophical analysis it can be demonstrated that there is a significant difference between the ideological content of the concepts of systems and the concepts of networks. Concepts of systems are basically imbued with modernist values, while concepts of networks are imbued with postmodern values. Taking into account that the postmodern position includes as its part the modernist one the interrelationships between systems and networks can be characterized. As an illustration the analysis of the concept of "organism" and its role in the understanding of the Internet will be presented.*

Keywords: systems; networks; organism; philosophy; modern; postmodern; Internet

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He studied physics and philosophy at the Eötvös University, Budapest. Now he is a lecturer in history and philosophy of science at the same university. His research fields include: history and philosophy of science, hermeneutics as philosophy of science, social constructivism, communication studies, and philosophy of the Internet.

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Human-commensurable Systems: from Complexity to Harmony

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Abstract: *An extended abstract for the proposed report at the symposium deals with some new features brought to system studies base on Morin's works by human-commensurable systems that present a subject for the contemporary science. Morin's philosophy is being compared and supplemented with major ideas of Russian and Ukrainian philosophers of the 20th c. A new humanist attitude enables us talking about value aspects of the observed objective reality and the fullness of sensual comprehension of the world by human personality, the interrelation between them no longer reduced to that of object and subject, taking instead the shape of more concrete and augmented phenomena.*

Keywords: human-commensurable systems; post-non-classical science; human subject; complexity; harmony; Weltanschauung

Edgar Morin's ideas of system thinking had great influence on our contemporary philosophy of science and Weltanschauung as a whole. However, future development of scientific and philosophical thought has led to the discovery of new features and dimensions of our understanding of systemic and complex phenomena, including those resembling rather notions of classical humanistic philosophy. In the proposed report, it is my intention to trace some of new concepts concerning philosophical aspects of systems and their relation to Morin's teaching on the method.

In Morin's words, science is to recognize 'the most objective category of knowledge' – the cognizing subject. At that, Morin considers only science being capable of comprehending its own cultural origins and answering the major questions of 'what is human?' and 'what is the world?' while denying philosophy and religion any cognitive potential and denoting those worthy spheres of human creative activities as non-scientific and speculative [Morin, 1977; Morin, 2007]. However, the notion of limiting the methodological apparatus of our understanding of the world and human beings, including systemic thinking used in the process of such understanding, with exclusively physics-based style of organization, does not sound well grounded at all, as the very possibility of reducing biological and anthroposocial organization to physical organization seems to be an oversimplification unfit for contemporary complex and systematic thinking.

In fact, that's one of major Morin's ideas that have their continuation and augmentation in today's philosophy. Introduction of the cognizing subject into the body of scientific knowledge stated by Morin finds its adequate supplement in Vyacheslav Styopin's ideas on post-non-classical science [Styopin, 1989]. While classical science used to leave the subject – the observer, the cognizing mind – outside of its body of knowledge, and that's where many conceptions of classical scientific paradigm share their opinions, there is a certain difference between non-classical way of thinking that is closely tied with relativism and dependence of the knowledge on the means of observation – and contemporary, or post-non-classical, paradigm, that takes into account the whole human subject as well.

In my opinion, the major discovery of Styopin that makes his ideas augment those of Morin, is that *values* of the subject of knowledge are to be included into scientific knowledge as well. In other words, human person could no longer be presented *as a subject only*, even in the sphere of cognition per se. ‘Subject’ is but an abstraction of human person that takes him or her just in a cognitive aspect while neglecting every other side of complex human being. Morin and von Bertalanffy had successfully demonstrated that a system could no longer be presented as a simple object; in the same way, human person could not reduced to a subject any more, – and that means a shift not only in humanities’ studies, but in our vision of objective physical and biological systems as well. Values, goals, and senses produced, experienced and professed by a human person have their full impact on the results of his or her scientific knowledge, in addition to all other spheres and forms of human cultural creative activity.

And that humanistic attitude changes our understanding of complex systems as well. For example, Russian scientist and philosopher Vasily Nalimov (1910–1997) used to criticize such prominent thinkers like I. Prigogine and M. Eigen for certain mechanistic dominance present in their views: if they say that order *may* become out of disorder, then that does not yet mean it *must* become out of chaos; the modality is somewhat different here. It is exactly ‘*the striking harmony that we observe in the living World’* that we should keep in mind while studying that world, Nalimov argues, and not merely complexity [Nalimov, 1985, p. 51–52].

Indeed, I think that the notion ‘harmony’ could be used as a certain ‘humanistic equivalent’ and value-driven synonym for the term ‘complexity’. At that, such harmony as a characteristic of a complex system is a reflection of both human (subjective) attitude and real (objective) feature, which are being taken in their complex interrelation now. That means that human subject is not just *an observer* of objective phenomena, as Morin used to stress. While still possessing that important quality, human person is now perceived as something more, as a *metaobserver* (using the term proposed by the already mentioned Nalimov). That’s, in my opinion, the next higher level of human relation to the world, compared to ‘subject–object’ correlation (used in classical paradigm of practice and cognition), and surpassing even the ‘subject–subject’ relation that reflects non-classical ideas of the paradigm of communication and ‘dialogue’ with nature, and consideration of human as an actor. A metaobserver is the one who adds values, senses and meanings to the results of his or her observation and actions.

The sensual unity of human person with the world is the major theme of Kiev school of humanist philosophy in the 20^{th} c., as well as a certain sphere of interest for the numerous philosophical currents dealing with the contemporary science as a practical philosophy. The world itself is in fact the part of Universe sensually and semantically grasped by human person, the part of the Universe that has value and sense for a human being [Ivanov, 1986]. So, the development and education of human person and his or her inner spirituality could in fact mean the evolution of the objective world as well, like the grandiose outer space of planets and stars could be either a pretext for crude everyday astrological prophecies – or the source of deep and fruitful philosophical wonder and incentive for great scientific discoveries.

That’s why post-non-classical science in its humanist philosophical reflections demonstrates even certain signs of neo-classical approach giving way to the return of order and even a kind of ‘geocentricism’ in the form of cosmological anthropic principle: humans are back from the non-classical periphery of the Universe... Of course, such an attitude plays even more important role in humanities and social sciences as well, replacing recently fashionable mechanicalism. Many social institutes, machines and systems could be perceived as results of historical alienation process, as exteriorized parts of human inner qualities, like will, reason, or judgment. So that with the development of human personality in the future, it would become possible, according to the idea of prominent Kiev philosopher Vladimir Shinkaruk, to replace (to *aufheben*) the state and the law with *morality* [Shinkaruk, 1968]. Indeed, the idea of democracy, for example, could be best described as such idea of human personality becoming the subject of his or her own life, the subject determining the fates of humanity while replacing with itself an obsolete Modern machinery of national state [see: Myelkov, Tolstoukhov, 2009]. And philosophy of human-commensurable systems, based on the development of Morin's ideas on the correlation of subjective position of human and objective knowledge of science, supplemented by humanist philosophy, could be an adequate source of inspiration for theoretical comprehension and practical achievement of the most desired forms of our common future.

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The Global System in Jeopardy of Collapse: the Club of Rome, System Sciences and the Limits to Growth Report

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Abstract: *This paper aims to explain how the project of the Club of Rome was influenced by the concepts drawn from system sciences, and how the Limits to Growth report of 1972 depended on System Dynamics (the modelling methodology chosen by the organization). In particular, it will describe the contradictions between the two main visions conveyed by the project: a vision of global breakdown, which is typical of environmentalism, and a vision of cornucopianism which is typical of technological forecasting. The study will present how these two visions intertwined in the Club of Rome project.*

The paper will then show how the very structure of the mathematical model was decisive in focusing the subsequent debate on the physical possibility of growth. It will also point out how several « global models » built in reaction to the Limits to Growth claimed to demonstrate the possibility of an ever-increasing economy.

Finally, my conclusions will help account for the fact that, paradoxically, the 1972 report about the "limits to growth" and its specific relying on systems science paved the way for the emergence and the raise of sustainable development.

Keywords: system dynamics; limits to growth; sustainable development

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Elodie Vieille Blanchard was trained in mathematics, history and history of science. She defended her Ph.D. about “The Limits to Growth in a global world” in June 2011 at EHESS (Ecole des Hautes Etudes en Sciences Sociales), Paris. Her research is about environmental politics, mathematical modelling and the management of global issues.

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Childhood as Complexity

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Abstract: *The various aspects of the understanding of childhood as ontological and gnoseologicalj complexity will be examined, showing some capabilities of Morin's approach for adequate modern consideration of childhood.*

Keywords: complexity; childhood; self-organization; post-non-classical practices

Recently complex non-linear constantly changing objects began to be in the range of interests of modern scientific knowledge. More and more the understanding of the functioning of complex nonlinear structures is transferred from the natural-scientific sphere in humanitarian, economic, social sector. Childhood as the complex phenomena also needs to be reconsidered from the point of modern methodological positions.

First of all a child is more complex than an adult. This complexity is caused at least by two factors. From one side, physical, mental, social development of a child proceeds rapidly and has an explosive nature. Complexity of a child is higher because its changing is appropriate for more complex set of development opportunities. From the other side, unique circumstances of a child's development, unique combination of social, cultural, family, historical, natural and other factors are added.

At second, it's more difficult to understand a child. Due to explosion of development, the strategies of adults that are adequate for the previous states, very often do not work in real time. That is, a child is difficult to understand because it is difficult to get the adequate information about a child.

So, there are two layers of complexity – the ontological complexity, which is reflecting the rapid and irreversible features of child development, and epistemological complexity - significant complexity of receiving information and understanding of these processes by adults.

One more difficulty is added to the first two ones. It's a cultural-historical phenomenon of childhood. It makes that complicated formation much more complicated.

Childhood as a unique and versatile phenomenon which has influence on the life of each person began to attract the scientists' attention at the end of twentieth century. The contemporary understanding of that phenomenon is complicated by errors and illusions which are typical to people's mode of thinking.

E. Morin said that knowledge is not a reflection of outward world. All the perceptions are the processes of translation and reconstruction of inducements and signals which take place in person's mind. That's why the necessity of revaluation of phenomenon of childhood appears. That revaluation is strengthened by contemporary methods and understandings of that complicated problem. We can name the main illusions erroneous statements about the phenomenon of childhood.

In the first place it's parents' nonprofessional and erroneous understanding of childhood as being transparent and simple. It gives rise to the simplified understanding of upbringing as adoption of certain rules of behavior and learning of necessary information. But it is not enough for educating self-respect and responsibility.

In the second place there is certain non-coordination between modern development of scientific knowledge and modern level of knowledge about phenomenon of childhood. To cognize that phenomenon, as E. Morin stated, we need to create the perfect and contemporary conception of upbringing. But the modern scientific culture does not allow to do it.

In the third place the experience of adults is not always suitable to young people. This phenomenon makes worse the relations between generations and complicates the understanding the phenomenon of childhood.

In the forth place the leaders of State don't pay necessary attention to the problems of childhood. It's necessary to change the whole process of training of the specialists in pre-school education. The real teachers must have the ability of artists. They must love children and give them all their talents.

Such people must not be usual educators but specialists in the field of development of child's personality. The training of such specialists is another complex problem which must be executed with the help of modern post-non-classical methods.

The works by E. Morin and some other scientists give a chance to examine the phenomenon of childhood more careful and invent effective strategies of activity. Being involved in the process of cognition both a child and an adult have influence on each other changing themselves.

The difference between an adult and a child in that process consists in the following – an adult understands the essence of that process and reflects on it, and a child needs to learn it.

The difference between the previous and the modern understanding of an adult's role consists in his (or her) necessity to watch his (her) change and correlation with a child. The intercourse of a child and an adult is post-non-classical practice. It means the understanding and interaction of those who cognizes and what is cognized.

So, a child as a single phenomenon and childhood as a social-cultural phenomenon are very complicated formations. Their development has an explosive nature. It is irreversible and probabilistic. The existing experience of adults isn't in time for a child's changes. It is just what causes the difficulties at its understanding. The interaction with a child is a postnonclassical practice. It demands the modern knowledge for all the adults and the special training for the specialists.

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Paradigm of Homo Complexus as a Challenge to the Contemporary Education

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Abstract: *The paper analyses the methodological possibilities of complexity paradigm for understanding contemporary education. According to the paradigm of complexity the human being as well as the society is viewed as a multidimensional and multileveled phenomenon. Homo Complexus has physical, biological, psychological, cultural, social, historical, and other dimensions. The author underlines that the complexity-based curriculum should be oriented to multi-dimensional nature of a human being, because education is declared to stimulate the inner potential of a human.*

Keywords: Homo Complexus; education; complexity paradigm; multidimensionality; knowledge; transdisciplinary

A complexity turn in social sciences began in the late 1990s. The increasing complexity of products, processes and organizations is determined by globalization, the increase of social dynamism, proliferation of computerized networks that are self-produced around the globe, forming and reforming themselves in new ways, connecting and presenting all parts of the world as a whole. The complexity theory, enriched by the works of Edgar Morin is perceived today as a paradigm in the field of philosophy of education. The paper analyses the methodological possibilities of complexity paradigm for understanding contemporary education. Its main theoretical bases are impact to review the anthropological, epistemological foundations of the contemporary education. Methodological reorientation is an important precondition of educational changes.

One of the complexity paradigm's bases is multidimensionality. A society is a multidimensional phenomenon. That's why I suggest that a new concept should be introduced, namely the "multidimensional space of possible socio-cultural shifts", the purpose of which is to examine the Ukrainian society as a transitional one. This space consists of many planes, in which different displacements take place *(Predborska, 2003, p. 269).* A societal transformation can be regarded as the simultaneous drift in all parts of these planes. The complexity of a human being could be perceived in the context of the society's multi-dimensionality.

A human being as well as the society is viewed as a multidimensional phenomenon. According to the paradigm of complexity the human being nature is multidimensional and multileveled. E.Morin argues that humans are, by nature, Homo Complexus, that embraces physical, biological, psychological, cultural, social, historical, and other dimensions, so:

"Pertinent knowledge must recognize this multidimensionality and insert its data within it. Not only should a part not be isolated from the whole, the parts should not be isolated from each other. The economic dimension, for example, is in permanent interretroaction with all other human dimensions; moreover, human passions, needs, and desires that go beyond solely economic interests are carried hologrammatically within the economic" (Morin, 1999, p. 14).

His paradigm of Homo Complexus based on the concept of the human trinity (individual-society-species) places a person in a situation, which allows at the same time vast diversity and specificity also. Humans are complex and being together both unity and diversity. Unity and diversity are understood as the notions that complete each other sooner than compete. At the same time they are not devoid of the diversity that contains the elements of antagonism. Human identity is carried in the form of plural and polymorphic human conditions.

The complexity paradigm without denying universality adopts the complementary principle that the individual and the local features are intelligible. It integrates elements into their ensembles, searches for principles of causal interrelations, places the object back into interaction with its environment or context, considers autonomy in terms of self-organization and self-production, self-reflection, thinks dialogically and so relates contrary concepts in a complementary manner *(Horn, 2008, p. 132)*. According to this paradigm's positions a person develops himself/herself in a dialogue with others, as well as in a dialogue with himself/herself.

The education is faced with the universal problems as the complex ones. According to the complexity paradigm, education has to redefine its main didactic principles from a controlled and controlling discipline-based education, predicted targets towards a discovered, transdisciplinary, emergent curriculum as a sum of proposed courses of study, as a core of the educational process. The complexity-based curriculum would be dynamic, relational, autocatalytic, self-organized, open, existentially realized by the participants, connected and recursive. Brent Davis analyzes how complexity theory might be appropriate to the concerns of educators and educational researchers. He addresses this question by exploring several 'simultaneities' offered by complexity thinking:

"Knower and Knowledge, Transphenomenality, Transdisciplinarity, Interdiscursivity, Descriptive and Pragmatic Insights, Representation and Presentation, Affect and Effect, and Education and Research" (Brent, 2008, p. 47).

Following his ideas I consider that the curriculum could be presented as a multidimensional space of possible educational interactions and meta-communications, based on such concepts as:

- transphenomenality as an attribute of an educational space and human being that offers through the lens of the complexity paradigm such approach to cognitive activity that can be possible only due to the simultaneous consideration of the factors, events associated with quite different phenomenal levels of explanation;
- transdisciplinarity as a means of the scientific cognition that presupposes the simultaneous consideration of the facts connected with quite different disciplinary perspectives;
- transdiscursivity as a communicative and cognitive practice that presupposes the simultaneous consideration of the facts connected with quite different discursive perspectives;
- transculturality as a situation in the present-day culture (including the process of unification and differentiation) that offers in the context of the complexity paradigm insights that can be possible only due to the simultaneous consideration of the facts belonged to quite different cultural traditions and value orientations.

Thus, from the complexity paradigm perspective the education is transphenomenal by its nature with the transdisciplinary character of cognition, and the transdiscursive essence of educational thoughts. The education strategy based on the transphenomenality, transdisciplinarity, transdiscursivity, transculturality are *sine qua non,* in which students and teachers become border crossers, and knowledge is understood as the result of their transgression. Students and teachers create borderlands in which all diversities are perceived as parts and a whole; socially, historically and culturally constructed limitations are destroyed.

The complexity paradigm regards knowledge as a social construct, created by participants of educational process at a particular socio-historical-geographical context. E. Morin writes:

"*Knowledge of isolated information or data is not enough. To have meaning, information and data must be placed in their context. To have meaning, a word needs a text which is its own context and the text needs a context within which it is stated "(Morin, 1999, p. 13).*

Such education project presupposes that students and teachers create together, share and shape themselves. The teacher, on the one hand, moves from the role as an expert and transmitter of knowledge to a facilitator, co-learner and co-constructor of meaning, co-creator of a new knowledge. Students, on the other hand, have to be prepared to exercise autonomy, responsibility, self-direction and self-reflection. The complexity-based curriculum conceptualizes difference, context, processes, multi-factor causality, presupposes the different ways of thinking about context.

The present-day curriculum would create the educational conditions for complexity thinking becoming.

Education is declared to facilitate the adaptation of an individual to the conditions of multi-dimensional, changing world, searching for new strategies, models of behavior and new outlook of contemporary person etc. According to E. Morin understanding as a means and end of human communication should be the result of education. He considers that the first rate task of the educational sphere is to overcome the dispersion of knowledge, which hinders to clarify the complexity and diversity of the person and the world in which she/he lives and works. The restoration of the unity of the fragmented knowledge, overcoming the fragmentation of knowledge in natural sciences and humanities, combining the parts into a whole will cause the creation of knowledge with new qualities, properties and characteristics in the educational sphere (the creation of the certain gestalt-image, which is in the process of becoming and changing).

The knowledge arises in the educational process, but is not previously given. It is the part of the inner world of those, who study, of their interests, values and goals. The nature of knowledge is subjective. Education should form the vital competencies of a contemporary person, that's why it is closely connected with her/his living world (the practice of everyday life should be involved). The ideas about the methods of acquiring knowledge are in the process of change. The method is considered not as the way defined a *priori*, but as the laying of this way. The configuration of the knowledge is considered as a cycle, a union, which is not reduced to a single meaning, but induces to a new reflection. Education is declared to stimulate the inner potential of a human. That's why we should use the methods, which are connected with the internal nature of the human – the play method, the dialogue, the research practice etc. Thus we expand the space of human possibilities by exploring the inner multidimensional nature of Homo Complexus.

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Transversality of Complex Thinking

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Abstract: *The paper deals with the problem of transversality of complex thinking. The concept of complex thinking is investigated in terms of E. Morin, E .Laszlo, W. Welsh theories, which open new horizons for intellectual strategies building. The central idea of the paper is transition and transitional states between different types of rationality. The author underlines that transitions, terminals, differences, relations form the environment of the complex thinking as a transversal one. It is actually the detection of transitions. The concepts of complex thinking and transversal mind have considerable heuristic potential in the present conditions of different positions existence.*

Keywords: complex thinking; transversality; transition; transdisciplinary; rationality; plurality and variability.

The current stage of the modern era can be described by means of the metaphor «Liquid Modernity» (Zygmunt Bauman). It helps to understand and express the character of the present as a transition with its instability, constant changeability, erosion of steady structures, and strengthening of the differentiation processes. The modern world requires new thinking that should be relevant in the world of plurality, in the endless fragmentations, interlaces, conflicting differences in the context of the global threats to being. The concepts of «Complex Thinking» (Edgar Morin), «Global Thinking» (Ervin Laszlo), «Transversal Reason» (Wolfgang Welsch), and others open new horizons for the intellectual strategies building.

The central theme of these concepts is the theme of transitions, the transition states between different types of rationality, the topic of transsectorial, transdisciplinary, transparadigmatic, and transdiscursive movement of the mind as a transitional or transversal one.

How can such transitions be possible? In conditions of the developed differentiation and specialization certain types of rationality form transsectorial constellations. Such relations point the possible ways of transversal thinking, showing that they as grammar are already included in the formation of certain types of rationality.

These constitutive interweaving of rationality types is detected at the level of analysis of the genesis of individual paradigms, which are always formed in opposition to one another. From the very beginning paradigms exist in the conditions of their change, reinterpretation and criticism. Certain conceptual constructions have interconceptual constitution. These interconceptual relationships provide an opportunity for interrational relationships of the transsectorial, transdisciplinary and transdiscursive type.

The substantial interweaves are determined by the fact that every concept is based on the historically-cultural background, which belongs not only to it but also to many other concepts. This basis always has common influence on them, for example, in the form of borrowings or in the form of specific interpretations. In addition, certain types of rationality often can be correctly understood only in the framework of their common context. Thus, individual rationalities, in spite of their autonomy, are characterized by numerous interweaves with other rationalities. It means that there are not only many types of rationality, but also a wide range of transitions between them, which, in turn, has a high degree of differentiation. Transitions, terminals, differences, relations form the environment of the complex thinking as a transversal one. It avoids the decrees, explicating, articulating, identifying gaps in the profile of rationality and thus contributing to its further development.

Due to its transitivity the complex thinking is a mediator in resolving conflicts of rationality, which could be resolved only through reflection over the limits, boundaries and interweaves.

The polemics with various forms of rationality requires such type of mind that could deal with difference and identity, without giving a preference to any party from the start. Transitional mind is exactly like that. It begins with a situation of distinction, but then emphasizes the possibility of transitions. Thus it is freed from the systemic one-sidedness.

The complex thinking as a transversal one is actually the detection of transitions. «Detection» means that concluding the transitions from the system as a whole deductively is impossible. They should be opened. At this level, there is a high value of feelings, intuition, and everything that was reflected in the ancient Greek concept of reason - «nous». A unity is implemented as a result, but only through the ability to transitions in a form that is fundamentally based on the diversity.

The recognition of implicit interweaves and explicit transitions - as it is considered in the concepts of transitional mind and complex thinking - helps to avoid despotism and repression of thought, and anarchy, because thinking in the mode of transversality overcomes the positions of absolute heterogeneity and incommensurability. In this case it can not be regarded as an antidote to the heterogeneity, but only as an intermediary between the explication of the heterogeneity and the transition between difference and identity.

The concepts of complex thinking and transversal mind have considerable heuristic potential in the present conditions of different positions existence.

Our plural reality requires the implementation of the transitions between the different systems of meanings and constellations of rationality. And this ability is carried out in a complex way of thinking. It provides necessary for after-postmodern forms of life: overcoming the closed limits, the transition from one system to another, the simultaneous consideration of multidirectional efforts, the ability to look across the paradigmatic walls.

Currently, the recognition of plurality and variability, the awareness of the boundaries and the need for transitivity is a natural requirement to the relevant thinking. Any absolutizing is contraindicated. It is important to move forward to ensure not just accepting a difference and treating it tolerant, but also respecting its own value, which means its support and protection. But every time we also need to focus on two aspects, which characterize the complex thinking: understanding the differences and the ability to transitions.

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Complex Thinking: Methodological, Managerial and Ethical Aspects

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Abstract: *We need complex thinking to cope with the complex world we live in. The main contribution made by Edgar Morin to the systems analysis and to the modern theory of complexity is development of principles of complex thinking and of complex epistemology (épistémologie complexe).*

Keywords: complexity; complex thinking; non-linearity; holism; self-organization; Edgar Morin

1. Two Fundamental Aspects of Complexity

Edgar Morin has an international reputation as a scholar who has make a contribution to elaboration of the general systems theory and the principles of cognition of complexity. In encyclopedia published by The International Society for the System Sciences (1977), his name was called among 30 the most outstanding scientists along with W. Ross Ashby, Gregogy Bateson, Ludwig von Bertalanfy, Heinz von Foerster, Ervin Laszlo, Magoroh Maruyama, Warren McCulloch, Humberto Maturana, Gordon Pask, Ilya Prigogine, Claude Shannon, Herbert Simon, Francisco Varela, and Norbert Wiener.

In my opinion, Edgar Morin's main contribution not only to the world scientific community but to humankind is the elaboration and promotion of the complex thinking.

In his "Method", he summarized conclusions drawn in the course of his reflections on complexity during the entire his life. The problems of understanding of complexity of the world we live in are multidimensional by their character, because the very complexity has many aspects, but there are two fundamental aspects among them.

The first fundamental aspect of complexity is holism, the connection of parts or elements leading to formation of a comprehensive whole which acquires new properties. The Latin word complexus signifies what is woven, interlaced together (Morin, 2002, p. 20), that a single tissue is created (lat.: complexus = com (cum) – with, together + pleco, plexi, plexum, ere – to weave, to twist).

The second aspect of complexity consists in the fact that any complex cognition, a complex phenomenon or a complex structure formation in nature or in society is torn up by deep, non-reducible contradictions. These contradictions not so much destroy the complex whole as build it. A complex structure maintains itself because it permanently, once-a-minute goes to ruin, undergoes destruction, prepares itself for crises and to attacks of chaos, as the theorists of self-organized criticality say, is poised at the edge of chaos.

The complex thinking doesn't set itself as an object to replace the certain by the uncertain, the separable by the inseparable, and the deductive identifying logic by triumphal coming of its principles. On the contrary, the complex thinking "favors the development of dia-logic between the certain and uncertain, the separable und the inseparable, logic and meta-logic. The complex thinking is not substitution of simplicity by complexity, it is rather the realization of a continuous dialogical movement between the simple and the complex" (Morin 1994, p. 249).

2. Seven Principles of Complex Thinking

When displaying the content of the complex thinking, Edgar Morin has formulated seven interrelated and complementary principles of such a thinking. These are 1) the system or organizational principle, 2) the principle of "hologram", 3) the principle of feedback, 4) the principle of recursive loop, 5) the principle of autonomy / dependence (self-eco-organization), 6) the principle of dialogue and 7) the principle of reintroduction of cognitive subject in the cognitive processes (see Morin, 1999, p.108-111, for more details).

It seems to me that in his new book "Vers l'abime?" Edgar Morin has made new important accents. He underlines that we need a thinking which will unite all that is separated and divided, such thinking which will respect multiformity of the united whole, when recognizing the single. According to Morin, the complex thinking is a) radical thinking which gets at the root of problems; b) multidimentional thinking, c) organizational or system thinking which analysis the correlation of the whole and parts; d) ecological thinking which doesn't isolate an object under study but considers its interrelations and its self-regulating ecological connections with the cultural, social, economic, political, natural environment; d) thinking which creates ecology of action and dialectics of action, i.e. thinking which is able to build a strategy which allows to modify or even to cancel the action undertaken by a subject; e) thinking which recognizes its own imperfection, carries on negotiations with doubt, but namely in action because there is no action without doubt (Morin, 2011, p. 39).

My view is based on the research results of the Moscow school of complexity studies, called also synergetics, at the Keldysh Institute of Applied Mathematics and at the Institute of Philosophy of the Russian Academy of Sciences. My teacher was Professor Sergei P. Kurdyumov (1928-2004) who is one of founders and inspirators of the synergetic movement in Russia (Samarskii et al., 1995; Knyazeva & Kurdyumov, 2010). The theory of complexity is under development here as a theory of very fast processes, blow-up regimes, localized structures formation and their evolution and co-evolution in complex (open and nonlinear) dissipative media. Most of the methodological and philosophical conclusions are based on severe results of the mathematical modeling and computer simulation of nonlinear evolutionary processes in such complex media. This view turns out to be very close to that of Edgar Morin.

The principles of complex nonlinear thinking bear in themselves the imprint of nature of principles as such. They are elements of open-ended system of knowledge. They are connected not only with pure, rationalized knowledge, but with human convictions as well. Therefore, to cultivate the principles of complex thinking means to learn the *art of thinking*. Equally, to gain ability to efficiently act in the complex surroundings means to learn the *art of activity* and of management. This understanding is consonant with the apophthegm of Paul Valéry: "Il y a *science* des choses simples et *art* des choses compliquées…L'intérêt de la science gît dans *l'art* de faire la science".

Edgar Morin is fond of citing Blaise Pascal's thought: "I believe it is impossible to cognize a part, if I don't know the whole as well as it is impossible to know the whole without having knowledge especially of its parts". Edgar Morin underlines today the importance of understanding of risks of disintegration of complex united structures and historical gains of eventual new integration. "All that is divided can be unified anew" (Morin, 2011, p.93). It is important to preserve diversity within the united structure as unitas multiplex in order the structure can develop dynamically.

3. Ethic of connection and participation in order to live in the complex world

Edgar Morin is not an abstract thinker, but a practitioner who thinks profoundly and globally. He draws some extremely important conclusions concerning the necessary reform of education in the world as well as ethics. One must work in order to think well (Pascal), and one should think globally in order to act locally. Edgar's ethics is ethics of connection, tolerance, understanding, freedom, solidarity, and belief in friendship. This is his practical philosophy or the complex thinking implemented in practice.

From my point of view, such ethics may be based on the idea of co-evolution. Co-evolution is a way of integration, of assemblage of elements, substructures in more and more complex structures in the world of nature and society. Co-evolution is *per se* “the art to live together”. To follow the rules of co-evolutions signifies to construct a preferable and sustainable future. Co-evolution is not simply a process of adjustment of parts to each other by formatting a complex whole, of their resonant positional relationship and of synchronization of tempos of development, but it is enactive cognition of the world by a human being, synergism of cognizing and constructing subject and of a medium surrounding him. This is also an interactive connection between human organizations and single individuals, the universal collaboration, complicity and solidarity, concerted efforts in construction and rebuilding of the world, and thereby of one’s own mentality. This is disclosure of universal affinity of all with everything and of mysterious connection between the past, the present and the future.

To know how to connect and to establish links becomes a predominate idea nowadays which takes root in scientific creative activities, in philosophical reflections as well as in ethics of human relations. Edgar Morin identifies himself with all people in the world who chooses as their religion the religion of love and integration of parts in a united and interconnected whole. The whole which finds new emergent properties that are absent in its constituent parts and which backwards exerts influence upon parts, when transforming them.

Cognition which connects is a way of cognition of complexity. Thinking which connects becomes a basis for ethics of connection, complicity and solidarity. Politics which connects is politics which knows that solidarity is a vital necessity for development of complex social integral structures (Morin, 1994, p. 323). The complex thinking has, thus, existential consequences and applications when promoting the mutual understanding between individuals, social organizations, state systems, when teaching tolerance.

The complex thinking is a part of open rationality. Edgar Morin underlines that complexity is a problem word rather than a solution. Complexity is for him a challenge rather than an answer. The method is by no means a concrete program but a general strategy of research and activities. It signifies that the method defines only general directions of search, builds certain lighthouses for cognitive and practical activities, which are undertaken each time in accordance with the personal research attitudes and worldviews, the concrete experience of a person who applies the method. Edgar Morin quotes word of Spanish poet Antonio Machado who wrote in 1917: “Wayfarer, your tracks nothing else than your path. Wayfarer, you have no path. The path is laid down in walking”. The word is used as epigraph to information letters published quarterly by the Association of complex thinking.

One day G.W.F. Hegel said: “When a man will change, the world will change”. Today we understand how words and thoughts are important for construction of a new world order. I do hope that Edgar Morin’s life and research program, the whole his activity of proclamation and promotion of the new complex thinking will change the world.

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Energy & Information in Systems

The Onset of the Worldly in Morin's Method

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Abstract: *In order to understand the transition from the field of possibilities for a world (the latter's non-being) onto the worldly proper (being), it is necessary to clarify the concepts of energy-matter and information-structure in terms of their concrete worldly nature and visualize them as the attributive outcome of a virtual process structure that determines the explicit form of the non-being in question. This is not only important for finding a reasonable grounding of the world under a scientific perspective (shedding its light therefore onto the various unification programmes presently under way), but also for securing an adequate grounding of the ground itself. Hence, metaphysical aspects show up as foundation of physical aspects. The relationship between these two categories of conceptualization is illuminated by utilizing the essential starting point chosen by Edgar Morin in the development of his unified theory of systems.*

Keywords: complex systems; evolutionary systems; networks; spaces

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Scientific Communication in the Context of Social-Cultural Changes: Gender Aspects

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Abstract: *The aim of the article is to reveal the complicated system of interaction of science and management forming a new communication; to attract attention to different positioning practices of women scientists in the scientific community.*

Keywords: social and cultural process; self-organization; system and synergetic approach; scientific community; communication; practices of positioning; woman scientist

A number of questions are offered to discuss:

- What is the role of the scientific community in management practice?
- What principles is the system of interaction based?
- How is important to society and scientists restoration of the principles of scientific ethos?
- How do social changes-orientations influence the democratic principles and expansion of commercial principles in the scientific sphere on female activity in scientific research?
- Can we say that the present information-communicative structures influence the expansion of the results of their scientific activity?
- What are the scientist's motivations to realize communications: requirement or functional obligation to be included in the process of management by engaging in consulting and expert-analytical, scientific project and social-control activity?

The author analyses the system of positioning including different types of social cultural practices aimed at achievement of a) professional status, b) social status, c) personal status positioning. Communications (as an important cultural component) can be aimed to decide definite purposes corresponding to one or the other role position.

The scientist's image is the sum total of views about him/her as a scientist (founder of scientific school, public figure) and person who has potential and talent for creative self-realization and plays different social roles successfully. Social culture strongly influences on positioning of the scientist as social subject and his social status and role.

At the present time information flow is so strong that if the scientist works out of the principles of openness and communication (i.e., personal communication, networking, seminars participation) his/her results can hardly be positively appraised. Such behavior is usually considered as deviation from the established standards of the modern scientific ethos.

The scientist's ego involvement into the system of communication partly functions as information filter, becomes an information laboratory. Interactive discussions and forums attract the scientist's attention because they make possible to cooperate and exchange ideas quickly. Networking has also negative aspects (as net attacks, personal explicit and implicit opposition – unfair evaluation of the scientist because of personal partiality and envy), which are considered as incorrect and unethical, destructing atmosphere of trust and constructive criticism.

The transdisciplinary methodology is becoming, on the one hand, in addressing the conceptions of social constructing, theories of public spheres, and others (E. Goffman, U. Habermas, P. Berger, Th. Luckmann, P. Bourdieu, M. Foucault, A. Giddens and others), on the other hand – the systems and synergetic approach. The complex system of interconnections of different actors, social and cultural factors and conditions influencing the communicative practices in science is discovering this way. The result of the author's analysis of the system and synergetic approach is the base of communicative model, the frame of it appeared in present Russian practice.

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Symposium B. Evolution throughout the Sciences and Humanities

Chairs: Werner Callebaut, Konrad Lorenz Institute for Evolution and Cognition Research,Altenberg, Austria, Rudolf Hanel, Medical University of Vienna, Vienna, and Manuel Wäckerle, Vienna University of Technology, Vienna

The symposium 'Evolution throughout the Sciences and Humanities' aims its focus at portraying the concept of Evolution from an interdisciplinary perspective. Evolution, as an idea, has lastingly been influencing sciences and humanities, which benefit considerably from adequately perceiving and adapting the basic conception of evolutionary processes according to the requirements of the various disciplines. While recognized principles of evolution offer versatile tools for scientific inquiry the laws of evolution are not reductionist in the same sense as laws in physics; the rules drive change on various levels of organization and time scales, between micro and macro, local and global, synchronic and diachronic conditions. The organizers invite to a symposium consisting of 3 complementary modules and one designated discussion session. The symposium highlights and tries to integrate biological-developmental, socio-economic and structural perspectives of evolution.

Werner Callebaut: *Toward a Philosophy for EvoDevo*

Stephan Handschuh: *Animals as Developing Systems – On the various Relationships of Individual Development and the Diversity of organismal Form*

Hardy Hanappi & Manuel Wäckerle: *Power as a Structuring Concept for Political Economy – Algorithmic Evolutionary Methods in Action*

Kurt Dopfer: The Generic Rule Approach – Economics in another Key

Jack Vromen: *Playing with the Price Equation – The Nature of Economic Selection*

Johannes Preiser-Kapeller: *A Complex Systems Approach to the Evolutionary Dynamics of Human History: the Case of the Late Medieval World Crisis*

Rudolf Hanel: *Evolution and Inference: towards a physics of science?*

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Toward a Philosophy for EvoDevo

Werner Callebaut

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Abstract: *In this talk I discuss the emergence of evolutionary developmental biology (EvoDevo) as a response to the essential incompleteness of the Modern Synthesis in biology. I characterize EvoDevo in terms of its conceptual framework, methods, and explanatory strategies, and try to introduce some order into the plurality of its theoretical perspectives. I also suggest that a philosophical naturalism committed to a non-reductionistic causal-mechanistic explanation is the philosophical theory that best fits EvoDevo and evolution at large (including cultural evolution). I argue that a proper understanding of EvoDevo requires a reconceptualization of the relationship between what counts as genetic and what as epigenetic. Central concerns are the generic, conditional (i.e., unprogrammed) generation of primordial organismal form and structure ('origination'), the question of evolutionary innovation—how novel elements arise in body plans—and the factors of organization, that is, how structural elements and body plans are established.*

Keywords: causal-mechanistic explanation; evolutionary developmental biology (EvoDevo); philosophical naturalism

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Animals as Developing Systems

On the various Relationships of Individual Development and the Diversity of organismal Form

Stephan Handschuh

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Abstract: *In this talk I want to focus on the role that individual development can play during the evolution of species or whole lineages of species. For many decades, developmental biology was very much excluded from mainstream evolutionary biology. Today, the Evo-Devo program aims to re-integrate organismal development into the core of evolutionary theory, arguing that development is an essential component in a causal-mechanistic understanding of phenotypic evolution. The ways in which development influences evolution are manifold; on the one hand development can be restrictive, represented by concept of developmental constraint. On the other hand development can be enabling, with small changes in the developmental system leading to notable changes in adult form. I will try to review how the notion of development itself evolved from the pre-Darwinian era until today, presenting both historical ideas and recent findings.*

Keywords: evo-devo; evolutionary theory; phenotypic evolution

About the Author

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Stephan Handschuh is University Assistant in the Imaging Core Facility at the University of Veterinary Medicine Vienna since 2012. He has studied biology and has lectured on 3D imaging and visualization methods, comparative morphology, and histology at the University of Vienna. His research interests are in evolutionary developmental biology, and in the methodology of microscopic 3D imaging and quantification of 3D image data.

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Power as a Structuring Concept for Political Economy

Algorithmic Evolutionary Methods in Action

Hardy Hanappi & Manuel Wäckerle

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Abstract: *The talk explores the concept of power and uses it to provide a new foundation for a conceptual framework of evolutionary political economy. This framework makes excessive use of the perspective of agent based simulation to keep all new notions clear, concise, and consistent. The artificial political economy is considered as a tribal society. The tribes' chieftains are involved in a game of power and exploit their farmers dependent on their chosen strategies. The model combines elements of a stock-flow consistent architecture of capital reproduction cycles, of agent-based bottom-up mechanisms and of evolutionary group-selection on a network topology.*

Keywords: evolutionary political economy; power; capital stock-flow circulation; agent-based modeling; group-selection on a network

As the object of investigation to start with an artefact called a 'tribe' – describing a hierarchical set of heterogeneous human individuals – is chosen. A tribe is structured in both directions: internally it consists of a structure of its members (farmers and a chieftain either warrior or priest), which endogenously influences its behaviour; externally it is one of many interacting tribes and gets endogenously influenced by the interaction of all tribes. Since neither a smallest possible entity nor a largest possible entity is exogenously assumed this setting allows for a full use of self-similarity – as needed by the field of application of this methodological approach. Internalized power – understood as ideology – is enforced by priests, which enable certain sets of internal farmer models, dependent on the economic input-output structure with regards to its production technology. They influence the operant rule structure of their tribe and consequently the path-dependency (stabilisation and de-stabilisation) of internal farmer models (priest-farmer link). Externalized power is realized within an institutionalization process between tribes. Tribes are connected through chieftains, which are responsible on the one hand for inner coercive power (warrior-farmer or priest-farmer link) and on the other hand for conflict exaggeration and resolution between tribes (warrior-warrior, warrior-priest and priest-priest links). This double character of power shapes the circular cumulative causation (history with feedback) of our artificial political economy, which allows for an evolutionary process with possible structural revolutionary breaks as wells as gradual continuity.

Tribes are initialized with a random level of production layers. On each layer a farmer-node is created with a uniform distributed capital stock. The model represents a stock-flow consistent setup of a one-good world, where farmers deliver the amount of goods forward to the next production layer in dependence on their technological capital-production ratio. The last farmer node delivers the final flow of goods to the chieftain, who is accumulating wealth. The capital-production ratio is conceived as a transportation technology, which gets endogenized via the chieftains. All chieftains are initially connected with each other and play an iterated chicken game on a network topology of a directed graph. Their links are weighted with a force, representing the mutual trust between them. Their neighbourhood is associated with a satisfaction factor, dependent on past cooperation and defection. If satisfaction is rather low chieftains tend to disconnect from other chieftains with the lowest mutual trust (force) and reconnect with other nodes, recommended from their neighbours.

Crucial element of the model is a relative power measure, responsible for coercive (external) or ideological (internal) power. The chieftain with the greatest wealth receives maximum power of 1, all other power values are calculated as the ratio of their power to the most powerful. This power value is then integrated into the link-updating rule, so that powerful chieftains are no likely to connect with less powerful and low power chieftains are looking forward to connect with more powerful chieftains. Of course this link-updating mechanism is dependent on the previously chosen strategy of either hawk or dove.

Warriors play hawk and are able to invest in weapon technology. If investment is feasible they are attacking foreign connected tribes. Dependent on their power values the attack is either successful or not. A successful attack leads to a robbery of foreign transportation technology (think of stealing simple transportation wagons for instance). Warriors equip their farmers with this new technology and are able to exploit capital faster than before. Farmers also receive a proportional amount of the warrior's loot. Priests play dove strategy and are able to invest in innovation to enhance their transportation technology on their own. A successful innovation leads to a better transportation technology, updating the farmers' capital-production ratio in the same way as it is conducted in warrior led tribes. Since innovation is more costly, this more hostile method is slower than the coercive one. Chieftains change their strategy if their relative power value falls close to zero. On the other side a tribe is wiped out if the total capital stock of a tribe's farmers also decreases below zero.

First simulation runs have shown the following preliminary results: (1) The initial number of production layers has a path-dependent effect on the flow of goods. Small tribes with few layers have an advantage in the short-run, because they are able to accumulate capital fast and efficient, but in the long-run they are getting vulnerable to attacks and punctuated structural breaks in the overall power distribution; if a tribe is wiped out for instance and power relations need to get diced again in consequence. (2) Warrior led tribes are exploiting their farmers faster than priest led tribes and may also die out faster. Nevertheless they are able to succeed faster if they have a high success rate of their attacks in the short-run, since priest-led tribes are easier to attack. Priest led tribes are able to engage in a more 'sustainable' type of production, where exploitation of farmers is rather low. (3) The group selection mechanism embedded in the network evolution allows priests to protect themselves in 'priest-tribe-cliques' in front of defecting warriors, whereas warriors act as 'lone-wolfs' using their high relative power as a first-mover strategic advantage. This notion delivers two basic stable outcomes, on the one hand a surviving priest clique of tribes and on the other hand just one surviving warrior tribe.

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Gerhard Hanappi is ad personam Jean Monnet Chair for Political Economy of European Political Economy. He is a senior researcher at the Technical University of Vienna – Research Group Economics and has been the project leader of numerous projects in this area as well as author of approximately 200 research papers. His expertise in team leadership and his international experience manifested in his four years executive directorship at the Austrian Academy of Sciences (soocioeconomics unit) and his directorship (scientific and administrative) of the Ludwig Boltzmann-Institute for Monetary Economics; in the first half of 2011 he was visiting professor at the University of London (SOAS).

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The Generic Rule Approach

Economics in another Key

Kurt Dopfer

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Abstract: *The presentation proposes a reconstruction of economic theory on the basis of a unified generic rule approach. It builds on a framework that distinguishes expressly between ontological, analytical and theoretical levels of enquiry.*

Keywords: evolutionary economics; complexity; ontology; mereology; structure; rule; mesoeconomics

At the *paradigmatic-ontological* level, three *axioms'* are introduced. The first proposes bimodality: all existences are matter-energy actualization of information - rejecting Cartesian dualism that divides the world into 'hard' material entities and 'soft' ones associated with information, knowledge or ideas. The second axiom states that all entities or particles have a propensity to associate giving rise to open-system contingency, self-organisation and structure. The third axiom recognizes existences as process: structure actualizes in time and space. The process is empowered by mechanisms leading to meta-stability or evolution of the 'process structure'.

An explicit distinction shall be introduced between *analytical* and *theoretical*. The latter pertains to the domain of a specific discipline; the former is supra-disciplinary embracing all disciplines and all of their theories. For instance, the term 'rule' used subsequently is analytical; in turn, the term 'gene' (biological rule) or Nelson-Winter routine (adopted economic rule) are theoretical.

Analytical terms and concepts allow us to bridge ontology with theory. They represent a *lingua franca* for cross-disciplinary research. Their hallmark is that they are not neutral with regard to their empirical application but rather, that they require to be ontologically warranted. For instance, much of the received mathematical calculus is in dissonance with evolutionary ontology while much of computational ontology is well in accordance with it. In turn, when employed at the level of a particular discipline or theory, analytical tools and methods (given the shared ontology) are neutral. The notion of 'analytical' allows us discussing systematically homologies and analogies and avoiding some of the pitfalls of the current discourse.

We introduce the following analytical key terms: *Rule, carrier, operations; as corollaries rule content, knowledge and information*. Enriched with their economic meaning, they represent the elementary units for theory construction.

A rule is a particular semantic content (e. g. instruction, idea or deductive format). for a particular kind of operation. For instance, applied to economics, a production rule is for the operation of producing or a decision rule for that of decision making. The conceptual term knowledge applies always to a carrier; an entity, such as agent, 'knows' by 'carrying' a rule. Information, in turn, denotes the locus of a rule in a process. For instance, a rule originates in a carrier or is being conveyed from one carrier to another. The concept of rule as information is instrumental for all models where information crosses boundaries of carriers or a rule is diffused in a population.

Significantly, rules are said to be *'generic'*. This goes generally with the meaning of representing a 'genus' of a class. A rule thus denotes 'generically' the class of all rules of a kind. However, this formal-analytical definition leaves in limbo the nature of class. Ontologically, this may attain two entirely different meanings. The term 'generic' may refer to a class or taxon where the genus is fixed, as in Linnaeus' binominal taxonomy or where, with the passage of time it may change, as dealt with in cladistic Darwinian taxonomy.

Being committed to an evolutionary ontology, the term 'generic' applies to a class of rules that change. In Linnaeus' case, the genus refers to a class of invariant rules; they expound characteristics of 'law'. Given their law-like nature, they may be called 'nomic' rules. Analogously, we have to deal with the notion of rules that change. We suggest as empirico-analytical (ontologically warranted analytical) term 'generic'. 'Generic' now represents a neologism. It applies not only to the formal-analytical notion of class genus but also to its particular nature. The term 'genus' is associated with terms familiar from the evolutionary sciences, such as gene, 'genotype', ontogenetic, epigenetic, genom, phylogenetic, or 'generative'. The matching with these familiar terms provides us with a bridge of *Verstehen* (but we could use any other term). Significantly, we distinguish between 'nomic' rules (fixed, mechanical) and generic rules (changing, evolutionary). Talking about rule or class of rules we always attach to them an ontologically generic meaning.

Equipped with ontological axioms and analytical concepts we may do some economic theorizing. First, theoretical flesh may be provided by introducing the distinction between subjects. i. e. human agents, on the one hand, and objects, i. e. all organized entities not being subjects on the other hand. The former are carrying subject rules, such as cognitive rules and behavioural rules; the latter object rules which represent generally organizational rules, which may be further distinguished into social or institutional rules and technical or blueprint rules. Many models have been devised addressing particular rules or carriers, such as cognitive, behavioural, institutional and technological models.

The rule approach proposed leads to a particular theoretical architecture. Let us highlight briefly some of its features. First of all, a systemic component must be stated in terms of generic rather than fixed rules. It may be modeled as generic process (axiom 3); specifically, as trajectory the dynamic of which may be captured by the phases of origination, selective adoption and retention of a rule. Further, structure emerges due to individual propensities to associate and negative feedback loops (axiom 2). Finally, premising theory on bimodality (axiom 1), the economy emerges as a two-level edifice: an invisible 'deep' level of rules – ideas, semantic information or knowledge - , and an observable 'surface' level representing their physical actualization.

A hallmark of evolution in complex systems is multiple actualization of a rule. This may apply across many carriers at a time and via descent over time. A rule evolves typically into a population of rule carriers. The component part represents therefore a regime composed of a rule (or rule composite) and a trajectory unfolding - in its 2nd and 3rd phase - into a rule population. Dealing with evolutionary complexity it is essential to distinguish between individual and population trajectory.

Received micro-macro falls short of providing adequate explanations since it fails integrating rule regime and population dynamic. Being neither micro nor macro the generic regime may be positioned – recognising its intermediate position - as meso. We obtain a theoretical micro-meso-macro architecture. Premised on bimodality, meso attains a dual nature. On the one hand, a meso rule relates to other meso rules representing a structure component; on the other hand, a rule evolves along a meso trajectory representing in this way a process component. Meso provides – in its bimodality – the essential key for dealing theoretically with structure and evolution. I submit that economic theory would be well served by addressing the various theoretical issues on the basis of a micro-meso-macro architecture.

Generic microeconomics may investigate into the dynamic of micro trajectory focusing on the particular fields of creativity and novelty (1st), selective adoption, learning, habituation and routine building (2nd), and retention of rule knowledge for recurrent economic operations (3rd). The generic rule approach serves as a tool for framing the questions and research areas relevant for theorising at the 'foundational' level about structure and change of the economy.

Generic mesoeconomics is a field currently much explored in the strands of evolutionary economics. The theoretical and more so empirical works are dealing with population dynamics, diffusion patterns, market selection, path dependence and many more fields. The term 'meso' is occasionally used for classificatory purposes but hardly in the context of theory making – inviting the conjecture that the reconstruction of economics on the basis of evolutionary and complexity thinking is not yet beyond its tender youth age.

Generic macroeconomics builds on meso foundations which in turn build on micro foundations. The analysis of the 'deep' macro level revolves around the little explored aspects of rule complementarity. The demur at investigating into the nature of ideas (the 'Platonic fear' is profound) has led to an almost entire neglect in dealing with its branch: mereology. As a consequence, works dealing with meso issues such as population models, path dependence models, selection models, etc. are difficult to link into macro structure. Some works connect with network models, but focus in these is still on the operational rather than generic level - which would highlight the growth of generic knowledge structuring 'deeply' the network. A generic network could be construed as net connecting nodes that constitute meso rule trajectories. The emerging generic structure could be further enriched by turning to mereology exploring the logic of rule complementarities. Evolution, essentially, is endogenous change of generic structure.

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Kurt Dopfer, Professor of Economics and Co-Director of Institute of Economics, emeritus from University of St. Gallen, previously three years Professor at International Christian University in Tokyo, five years research fellow of Swiss National Science Foundation, visiting professor at various institutions including Queensland University in Brisbane, Technical University Dresden, Institute for Advanced Studies in Vienna. Numerous publications on evolutionary economics, ontology and methodology.

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Playing with the Price Equation

The Nature of Economic Selection

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Abstract: *Suppose a firm in some industry makes more profits than its competitors because it possesses a particular trait (say a particular set of rules and routines) that its competitors lack and is consequently able to increase its market share (and that of the routines and rules it carries). Nobody denies that this presents a clear if not paradigmatic example of economic selection. But what about other, more contested examples? What if a profitable firm imposes its organizational template on newly founded chain outlets (in the spirit of, say, MacDonald's)? Does that qualify as an instance of economic selection? Or is it rather an instance of replication? What if a profitable firm is imitated by other firms, or if a firm reinforces its successful routines while dismantling and replacing its unsuccessful routines? Do these qualify as instances of economic selection? Or are they forms of diffusion (as a subspecies of replication) and transformation, respectively?*

Keywords: evolutionary economics; selection; price equation

Lately, a growing number of evolutionary economists (such as Andersen, Metcalfe and Hodgson and Knudsen, but also someone as Henrich, 2004) have come to share an enthusiasm for the use of the work of George Price (notably his Price equation) to shed light on foundational issues in evolutionary theory (in evolutionary theory, conceived more broadly, this enthusiasm is shared among others by Steven Frank and Andy Gardner). They believe that Price's work is particularly helpful in elucidating the concept of selection and in distinguishing the effects of selection from those of other evolutionary mechanisms such as mutation (or innovation). It is argued that these enthusiasts are right that the Price equation presents a very general way to account of evolutionary change. The scope of the Price equation is not limited to biological evolution, for example, it can also span socio-cultural evolution. Because of its possibility for recursive expansion, it also lends itself naturally to an analysis of simultaneous evolution at several adjacent levels (viz. multilevel selection). Indeed, I will argue that the Price equation is so general that it can cover not only the evolutionary forces of selection and mutation (and other biases in transmission), as enthusiasts argue, but also random drift. To be more precise, the "covariance" term in the equation that is supposed to keep track of selection effects do not only track the effects of selection proper, but also of those of random drift. There are ways to disentangle the effects of selection and random drift, but this necessitates going beyond the Price equation.

Thus the Price equation is even more general than enthusiasts proclaim. It can account not just for selection and transformation and their respective effects, but also for random drift and its effects. What the Price equation offers, however, is a statistical partitioning, not necessarily a causal one (as, e.g. Okasha 2006 makes clear). At the same time, the Price equation can be said to be less general than enthusiasts proclaim. There is no room for evolutionary mechanisms such as migration and multi-parenting in the original Price equation. In an insightful paper, Kerr and Godfrey-Smith (2009) show that the original Price equation only allows for one sort of connection: each entity in the descendant population is connected with just one entity in the ancestral population. What the original Price equation rules out is, first, that there are entities in the descendant population that are unconnected to any entity in the ancestral population and, second, entities that are connected to several entities in the ancestral population. Kerr and Godfrey-Smith make room for these possibilities of migration and multi-parenting by adding a second covariance term in a generalized Price equation. But like the original Price equation, their generalized Price equation does not unequivocally causally decomposes total evolutionary change into separable causal forces (or mechanisms). One principal reason, it is argued, is that for any given socio-cultural evolutionary process, involving social and/or individual learning, it is possible to represent evolutionary change in different ways, depending on what sort of entities the ancestral and descendant population consist of.

The crux is that processes of learning can be represented not only as processes of transformation of interactors (the carriers or bearers of the relevant traits), as e.g. Wenseleers et al. (2011) do, but also as Darwinian selection processes in their own right. Moving from the former to the latter provides the key to understand what evolutionary theorists such as David Hull mean when they argue that socio-cultural evolution need not be seen as a Lamarckian process, involving the biological inheritance of acquired characteristics, but can be seen as a Darwinian process in its own right. If we conceive of learning as a Darwinian selection process, the entities in the ancestral and descendant population are no longer carriers or interactors that change their trait in the course of learning, but the traits themselves that differ in their success to propagate in a population. It is shown that, depending on how we represent the entities in the ancestral and descendant population and their connections, we get altogether different partitionings if we use the Price equation to account for evolutionary change. The same evolutionary process, having the same particular causal structure, will have completely different statistical partitionings. What in the one representation comes out as an exclusively transformation effect appears as an exclusively pure selection effect in the other.

All this should give us reason to pause and reconsider the differences in meaning of the notion of selection in socio-cultural evolution, in individual learning and in biological evolution (as also Hull et al. 2001 recommend). Does selection always involve environmental interaction, as Hull and others maintain? Or is it enough that instructors and teachers select their pupils, or that, conversely, learning “children” select their cultural parents? Appearances notwithstanding, the Price equation does not help in making more clear what we should call selection and its effects and what we should treat as other forces and mechanisms than selection and what we should treat as their effects. The upshot is that the strength of the (generalized) Price equation is also its weakness. It seems it can account for any change in an average trait in a population, not only change that is commonly considered to be evolutionary change. It brings out striking similarities and dissimilarities between different sorts of processes. It allows us to see migration as the mirror image of viability selection, for example. These similarities obtain only at a high level of abstraction. Because of its high abstractness and generality, it is able to connect and unify many different processes. But by the same token the similarities that it highlights between these processes are rather weak ones. The Price equation slides over important causal differences between these changes at a less abstract level. For many purposes, the dissimilarities between them at more concrete levels might be the more significant ones.

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Jack Vromen is professor of Theoretical Philosophy at Erasmus University Rotterdam. He is also academic director of EIPE (Erasmus Institute for Philosophy and Economics). Since his Ph.D research on Economic Evolution (Routledge 1995) he is hooked on theoretical and meta-theoretical issues in Economics and Evolution. Recently he also developed research interests in Neuroeconomics, in social mechanisms and in the Economics Made Fun genre.

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A Complex Systems Approach to the Evolutionary Dynamics of Human History: the Case of the Late Medieval World Crisis

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Abstract: *The paper aims at a combination of the qualitative relational approach to social systems established by Niklas Luhmann with the quantitative and structural approach of network theory and complexity sciences in order to demonstrate the explanatory value of a complex systems approach to the evolutionary dynamics of human history for a specific period between 1200 and 1500 CE in a global comparison.*

Keywords: social evolution; complexity theory; systems theory; medieval history; comparative history; evolutionary dynamics; network analysis; analysis of crisis; extreme events; environmental history

„**There are few** theoretical approaches to which historian respond so negatively as to the explanation of historical processes by such theories“, the German historian Rainer Waltz states most accurately in his study on „Theories of Social Evolution and History“; there he also presents two main causes for this rejection: a moral one, the perversion of evolutionary thinking in so-called Social Darwinist theories in the 19th and 20th centuries, and a scientific one, the fear of a biologistic interpretation of human history by adopting evolutionary models (Walz, 2004). This distinguishes historical studies from other social sciences and humanities such as anthropology or sociology and even other historical disciplines such as archaeology, where evolutionary models have become part of the methodological toolkit (Renfrew & Bahn, 2008; for a rare example from the field of history of literature cf. Moretti, 2009).

Although most historians are reluctant to adopt evolutionary models (yet alone in their mathematized or sociobiologist form) for the interpretation of human past (respectively the larger or smaller period of time they are specialised in), terms such as “evolution” and concepts of evolutionary thinking such as “adaption” or “selection” are used in numerous descriptions of historical events and processes, albeit often in a metaphorical way (Walz, 2004). At the same time it is evident that major developments in human history such as the emergence of the human kind itself, of human culture and of complex social structures such as states as well as phenomena of long duration (up to the scale of “Big History” from the Big Bang until present times as it has been attempted in the last decades, Spier 2010) cannot be explained without the help of evolutionary concepts (cf. Blute, 2010; Voland, 2009); but again, these subjects refer mainly to the fields of evolutionary biologists and psychologists, anthropologists, sociologists or (prehistoric) archaeologists (cf. Yoffee, 2004). Some specialists from these disciplines have also tried to adapt such concepts for the entire human history beyond its “beginnings”, but have equally found mixed reception among historians, especially if they try to demonstrate some kind of progress in the development of humanity as for instance Steven Pinker has done most recently in his study on “Why Violence has declined” (Pinker, 2011; see also Atran, 2002; Boyd & Richerson, 2005; Morris, 2010).

In contrast to this (non)-use of evolutionary concepts for historical studies, we intend to demonstrate the benefit of a complex evolutionary approach for the analysis of a specific period of late medieval/early modern history between 1200 and 1500 CE, which has been attributed central importance for the so-called "Rise of the West", since it saw the beginning of European overseas expansion at its end (cf. Goldstone, 2009; Morris, 2010).

In the "calamitous" 14th century, as Barbara Tuchman called it (1978), the medieval world entered a period of severe crisis in demography, economy, politics and religion. This crisis took hold in all regions, ranging from China in the East to England in the West. Even before the catastrophic pandemic of the Black Death (1346-1352), deteriorating climatic conditions had ended the period of demographic and economic expansion that began in the 10th century (Behringer, 2007; Atwell, 2001; Benedictow, 2004; Brook, 2010).

The local and regional impacts and consequences of these general crisis-laden conditions may have differed; outcomes ranged from actual societal collapse to the emergence of powerful new polities. But these conditions provide a framework for global perspective on this period and allow us to use the 14th century-crisis as a field of "natural experiments of history", as Jared Diamond and James A. Robinson have called them (Diamond & Robinson, 2011); accordingly, we analyse how similar crisis phenomena influenced the development of societies with different (or similar) traditions, religions, institutions, geographies or ecologies (cf. also Borsch, 2005). In particular, we will analyse and compare five polities in the "Old World", England, Hungary, Byzantium, Egypt and China, of which three disappeared around the end of this period due to the expansion of the most successful newly emerged Ottoman Empire (Byzantium in 1453, Mamluk Egypt in 1517, Hungary in 1526/1541; cf. also Preiser-Kapeller, 2011).

In order to be able to capture variations and complexities within this sample, we adopt concepts and tools provided by the field of complexity science. We understand complex systems as large networks of individual components, whose interactions at the microscopic level produce "complex" changing patterns of behaviour of the whole system on the macroscopic level. In the last decades, historians and social scientists also tried to use concepts of complexity theory for the description of phenomena in their own fields, but again often only in a "metaphoric" way (Gaddis, 2002; Hatcher & Bailey, 2001). Less frequently, though, historians have tried to make use of the mathematical foundations of complexity theory or of quantitative tools provided by this field (Kiel & Elliott, 1997; Preiser-Kapeller, 2012). Recent scholarship has implemented some of these tools especially for the construction of macro-models of socio-economic development (Goldstone, 1991; Turchin, 2003; Turchin & Nefedov, 2009).

In addition, we combine complexity theory with the analytical framework of "systems theory" developed by the German sociologist Niklas Luhmann (1927-1998) in order to capture the interdependencies between politics, economy and religion within a polity and with the political, economic and ecological environment (Luhmann, 1997; Becker & Reinhardt-Becker, 2001; Becker, 2004). Luhmann´s theory is valuable for our analysis in various aspects; it makes us aware of the reduction of environmental and social complexity which is reflected in our historical sources, and it provides a framework to approach complex mechanisms within and the dependencies between various social spheres and their environment. Its evolutionary aspects have also been analysed by Walz (2004). In addition, we employ methods and tools of network analysis, which allow us to capture, analyse and model linkages and cause-effect correlations in society, economy, politics and religion on the macro- and micro-level down to groups and individuals (Gould, 2003; Lemercier, 2005).

Overall, our analytical approach allows us to capture the "diversité véritable" without losing track of essential commonalities (the "strange parallels", as Victor Liebermann has called them, 2009) with regard to the transformation of polities and societies and their adaption to this "first world crisis". Thereby, the value of a framework of evolutionary dynamics for the exploration of human history will be demonstrated.

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Evolution and Inference: towards a Physics of Science?

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Abstract: *Physics has been the first science integrating all three main aspects of sciences, experiment, quantitative model, and induction. The induction process itself is a two-stroke evolutionary process. One stroke is the feedback-loop involving the phenomena, the experiments producing data, the other stroke is a social feed-back loop, the language game scientists play amongst each other. A quantitative understanding of this process can be constructed using the same methodology that is proving to be useful for dissecting the properties of other evolving complex systems. The experimental side of complex systems analysis however is experiencing a boost by new "democratic" technologies (storage capacity, open online databases, …) lately – the impact of these technological innovations on methodology and inductive principles can't yet be predicted, however innovative methods that have been implemented lately may indicate - that the impact will not be negligible.*

Keywords: complex systems; quantitative models; evolutionary dynamics; network analysis; inference; self-organization

The face of science (i.e. the sciences) is changing due to a number of factors. Three major driving factors are (i) logistic limits to the growth of science, e.g. limits to the number of scientific positions, limits to project funding, the capacity of scientists to read the papers relevant to their expertise, etc. (ii) emergent new technologies (internet, memory, mobile phones, experimental technology, ...) transform media, communication, self-organization of communities, etc., and (iii) a growing need for understanding complex questions, e.g. dynamics of economy & finance or the human impact on the global network of ecosystems, etc.

These factors create new challenges, pressures and constraints for conducting science. Yet, these factors also introduce new possibilities and opportunities for creative scientific endeavors. Something quite intriguing may be about to happen on the way, which – due to missing technological means - was until recently impossible to accomplish; a *physics (or natural science) of the sciences*, which, as we will discuss in the sequel, is in fact the logical consequence of what has begun as philosophy and theory of science with laying theoretical foundations to a science of science. Science however, requires an experimental component, which is exactly what science of science required in order to test its theoretical considerations. Of particular interest here is how induction and inference works in societies. These developments have huge potential to provide understanding and means of managing the many aspects of the *enterprise science* as both a sociological & economical phenomenon and a key-node of human culture with one sole purpose, to stimulate and satisfy curiosity and creativity wherever and for whatever reasons these two blossom.

Science of science, as philosophy of science, is in fact anything but new and assisted during the birth-hours of the *scientific method*, with its three pillars (i) Induction – Bacon, (ii) Experiment – Galilei, and (iii) the Quantitative Model – Newton, with an extensive body of literature dealing with various aspects and problems associated with the scientific method (e.g. Wittgenstein, Tarski, Popper, Lacatos, Kuhn, Feyerabend), such as the problem of comparing competing theories and the inference problem. Also Whiteheads introduction to process philosophy (Whitehead) shares some precise observations: *Scientific work is to discover "first principles" rather than to deduce from them* confirming induction as scientific method. The fallacy of misplaced concreteness roughly can be translated into *too much detail can't be justified in all data-driven models of complex phenomena*. Such models have to be inferred from finite amounts of noisy data. The fallacy therefore confirms the method of *reduction*. *Established theories are never disproved, but eventually given up* (for an emerging in some sense better theory/model) is an observation of interest here, as it confirms a dynamic property of the scientific process shared with other complex systems – tipping points and punctuated equilibria (Niles & Gould). *Paradigm shift* are nothing else than a what is called a tipping point, or conformal phase-transition otherwise. With its passing generations of interacting scientists, its heritable information in form of a growing stock of documented scientific work, data, and open questions of interest, the process of science is obviously an *evolutionary system* on its own. That science is an evolutionary system can already be found in the work of Popper (Popper). Kuhn confirms this and also reinforces the importance of the social component of science, in agreement with Wittgensteins social resolution of the *induction problem* in terms of language games (Wittgenstein).

So what is changing in the science of science? One thing, the genuine possibility for large scale quantitative modeling and experiments! This however allows a leap from philosophy & theory dominated to a data-driven kind of science of science, which can be considered only since recently, due to the unprecedented possibilities of doing *experiments* in this field, provided by new emerging technologies.

Of what nature are such experiments? For example, language games have become an experimental reality which is used for physical grounding of embodied autonomous agents, in fields of robotics (Steels). Agent based models allow to assess systemic effects of science – administration, like the impact of peer-review on the quality of selected papers (Thurner & Hanel). Models of the human knowledge become available (almost for free) due to self-organizing projects like *WikipediA* (wiki); models of scientific output, in open paper-repositories like arXiv (arxiv). Models of human communication and interests can be derived from platforms like Twitter [twitter]. Various disciplines have begun to build large open databases which make available the treasures of experimental data to virtually everybody. Text-based models of knowledge and science can in principle be analyzed by means similar to methods as the ones developed in the micro-biological field of genetic interaction networks. Social behavior can be analyzed with massive multiplayer online games (Szell). Even Feyerabends dream of science being a social enterprise involving anybody who cares to participate is not just a dream any more, but webpages like foldit (foldit) have even begun to draw measurable scientific benefit from involving the interested public in performing research. Foldit for instance invites the public to help optimizing and exploring the folding-structures of proteins. The methodological anarchism that is embraced this way simply optimizes the chance to proceed from good to better and more successful methods. These new technologies are also neutral in the sense, that various different scientific disciplines, being subject to their distinct internal requirements and constraints, face comparable efforts for implementing strategies to utilize new technologies for a science of their distinct science - including tasks like implementing open and comprehensive databases or performing automated literature searches on scientific out-put in this field (which may help to ease one of the logistic problems in the sciences, that scientists in general are no longer capable to read everything that gets published in their own field of expertise) or the intellectual creativity required for inventing ways to motivate the public into investing man-hours of work into solving scientific puzzles or other tasks where the public may support specific tasks in specific research questions.

We are going to discuss a selection of aspects concerning a potential physics of science. We will recognize science as a physical social process which basically uses energy and resources to acquire and model information about the realities of our existence by employing a two-stroke strategy with one feedback loop in making experiments/experiences about the phenomena of interest (physical grounding of reason) and another social feedback loop in the scientific community (Hanel). We will discuss how abstract models of evolution (Klimek) allow us to understand much of the problems analyzed in the theory and philosophy of science. One important aspect is the relation between probabilistic inference and the principle of induction and how evolutionary mechanism socially distributes and stabilizes inference in terms of models of the pragmatics of autonomous embodied agents. Other aspects touch the question of guiding principles (principle of variation and selection), logistic constraints (administration, competition & the tendency towards average), the structure of models of science, data driven or predictive social inference as a means to solve complex problems, and the potential benefits of an increasingly self-aware and openly visible science.

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Symposium C. Systemic Approaches to Regional Disasters

Chairs: Gerhard Chroust, Johannes Kepler University Linz, Linz, Austria, and Nadine Sturm, Research Institute of the Red Cross Austria, Vienna, Austria.

Awareness of threats and the occurrence of actual disasters (many caused by nature but often triggered by human activities) have become more acute during the last decades, endangering a growing number of persons and areas in many different ways.

One has to

- predict and anticipate potential disasters and to design adequate avoidance strategies,
- prepare appropriate emergency plans both for the general public and emergency personnel based on accumulated knowledge and empirical best-practices,
- establish, organize, and train First Responder units (fire brigades, ambulances, police, technical aid teams, etc.) to intervene in case of a disaster,
- simulate interventions based on emergency plans and ad-hoc situations during training and interventions,
- provide realistic, but still safe training environments,
- provide fault-tolerant communication means for status information and logistics during an intervention,
- plan and anticipate appropriate post-disaster recovery activities,
- consider psychological and cultural differences and problems.

Today's information and communication technologies (ICT) can support and improve above activities, sometimes in ways not anticipated before. They allow for speedy aggregation and presentation of data and information in new ways, offering improved systemic interpretation, assessment and decisions.

This symposium intends to trigger an interdisciplinary exchange of ideas by including persons with different viewpoints and experience like practitioners, system scientists, IT-specialists, and human factor specialists.

We call for papers which take a systemic view on all types and origins of disasters and attempt to identifying similarities, analogies, and differences , giving raise to cross-disciplinary learning and application.

Some of the possible specific subtopics are:

- Classification of disasters and their interactions and effects (e.g. earth quakes, floods, air traffic breakdown due to volcanoes, chemical explosions, …),
- Analysis of typical emergency scenarios,
- Training support for First Responders using modern technology (e.g. Virtual and Augmented Reality, System Dynamics models, human evaluation models),
- IT support for prediction, tactical and strategic planning, and interventions (victim detection, tracking first responders, logistic of transport vehicles, …)
- analysis of deficiencies and improvement of organizational structures (e.g. Viable system Models, ISO standards),
- protection of emergency personnel (e.g. early danger detection and warnings),
- identification of road maps for further studies and investigations.

Gerhard Chroust: *Challenges in Reaction to Regional Disasters*

Paola di Maio: *Socio-systemic Analysis: The Case of Costa Concordia, a Tale of Two Disasters*

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Francisco J. Aceves: *A Systemic Comparative Analysis of Japan 2011 and Chile 2010 Earthquakes-Tsunamis*

Yoshihide Horiuchi: *Systems Design Analysis of Stranded Commuters Behaviors*

Karin Rainer, Verena Grubmüller, Igor Pejic, Georg Lankmayr: *Social Media Applications in Crisis Interaction*

Merrelyn Emery: *Strategies for Regional Disasters*

Vilmary Cuevas: *The South American Integration and Cooperation in Natural Disasters*

Tatsumasa Takaku: *Risk Management and Regional Distribution of Disasters*

Daniel M. Dubois, Viveca Asproth, Stig C. Holmberg, Ulrica Löfstedt, Lena-Maria Öberg: *Anticipatory Modeling and Simulation for Inter-Regional Security*

Neal Richard, Bell Sarah, Wilby Jennifer*: Emergence in the Disaster Response to the June 2007 Hull Floods*

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Challenges in Reaction to Regional Disasters

Gerhard Chroust

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Abstract: *Regional disasters (floods, fire, earthquake, etc.) have always threatened people in multiple ways, often in more than one way. This presentation aims at identifying and classifying disasters in their various aspects in order to be able to prevent disasters, to properly react to disasters, and to minimize consequences of disasters. Special emphasis will be put on interventions by First responders (Fire brigades, ambulances, police, etc.). Interventions are discussed in relation to resilience and dependability of (social) systems.*

Keywords: ICT; disaster reaction; human factors; resilience; dependability; First responders; training

Acknowledgement: This work was sponsored by project "KIRAS PL3: SimRad.COMP "Simulations- und Informationssystem zum Administrieren von Hilfseinheiten bei Katastrophen", Project number 818784, Oktober 2009 by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT).

1. What is a disaster?

1.1. Definitions

Depending on one's personal views and one's world view there are different ways of considering and defining a "disaster" (Tierney et al., 2001; Quarantelli, 1985):

an event with dramatic consequences: A *disaster is a natural or man-made hazard that has come to fruition, resulting in an event of substantial extent causing significant* physical damage or destruction, loss of life, or drastic change to the natural environment.

need of outside help: We presume that the affected persons cannot surmount the problems without outside help - an intervention is necessary.

loss of system viability: Where the system transgresses the boundaries of what is considered to be acceptable or safe.

a social/political construction: Disaster events and their impacts do not exist *sui generis but rather are products of social definition.* Thus *"disasters are in the eye of the beholder"*.

the social disruption: A break-down and destruction of a civilization (Diamond, 2005).

1.2. Resilience and Dependability

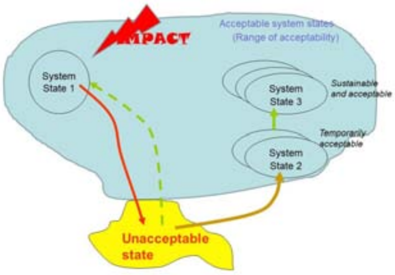

Figure 1: Acceptable and unacceptable system states and transitions

As a stakeholder we hope that the systems around us are reliable and that they are dependable (Chroust et al., 2009a): this means that a system behaves as we expect it to. Dependability is a complex, multidimensional property including safety, security, reliability, availability etc. (Schoitsch, 2005). In case of a disaster we hope that the system - usually with outside help - can be brought back into a dependable state, usually not into the original state, see (McEntire, 2007, chapter 9).

1.3. Classifying Disasters

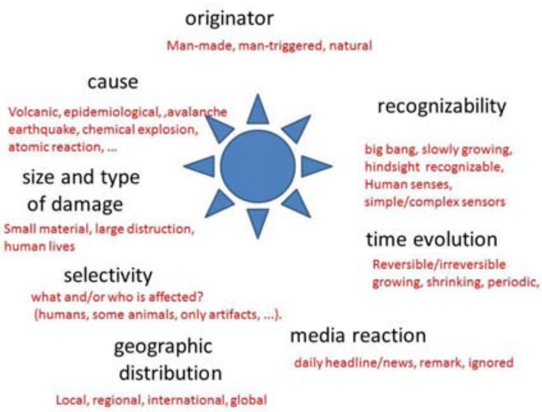

Figure 2: Classification of disasters

Regional disaster can be classified according to many different dimensions (fig. 2).

2. Reacting to Disasters

2.1. Phases of a Disaster Situation

It is important to distinguish the various phases of a disaster. In each of the phases different reactions and as a consequence different behaviors and competencies of the stakeholders are needed.

Fig. 3 shows the five key phases of a disaster scenario. They are rather obvious, but due to varying types of overlap a clear delimitation is impossible.

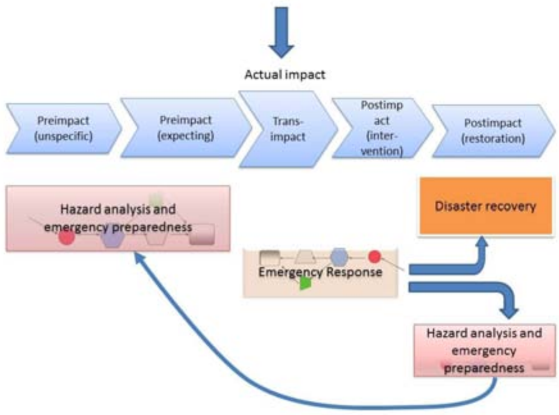

Figure 3: Disaster Phases and corresponding response processes

2.2. Reaction types

For humans and animals (individuals and organizations) we observe several basic types of reactions when confronted with a dangerous situation (fig. 4). The (conscientious or intuitive) reaction depends on a multitude of factors like information (very important), pre-warning, culture, psychological state etc. (Tierney et al., 2001, chapter 3).

Figure 4: Fundamental (Re-)Actions

3. Interventions and their Organisation

We presume that the affected persons cannot surmount the problems without outside help - an intervention is necessary.

3.1. Intervention Systems

While the main challenge for the Intervention System (fig. 5) is a speedy reaction, the Restoration System has to provide effective, efficient and long-term sustainable solutions. Its actors will be specialist, while the actors in the Intervention System usually will be generalists.

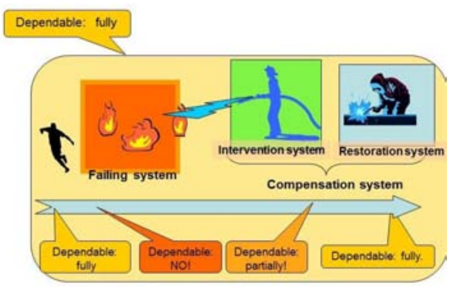

Figure 5: Intervention and Restoration System

For regional disasters a automatic, mechanistic response system is not sufficient. In the real world one cannot predict all possible disasters, as we must be *"Facing the Unexpected"* (Tierney et al., 2001).

3.2. Intervention Systems: First Responders

Taking into account the natural, technical and societal components of a disaster together with the many emerging unknowns only a socio-technical system with strong human involvement can provide sufficient variety ("Required Variety") to cope with the often unexpected situations of a disaster and its aftermath and thus will be able to prove itself as an adequate Intervention System: We need humans, but supported by know-how, experience and whatever technology is available. This was understood from very early times on. See (Kenlon, 1913) for a historical view on Fire-fighters.

Nowadays we rely on fire brigades, ambulances, police, technical aid teams, summarily called First Responders.

3.3. Intervention Processes

Interventions by First Responders are processes, which usually follow well-established process models. There are definite ’before’ and ’after’ activities supported by methods (e.g. how to approach a fire) and tool (pumps, ladders,...). The difference to other engineering processes is that the ’product,’ if one may say so, is different. They produce a service, not a product.

4. Psychological Problems of Disasters

4.1. Disaster Victims

In (IASC, 2007) one finds: *"... disasters cause significant psychological and social suffering to affected populations. The psychological and social impacts of emergencies may be acute in the short term, but they can also undermine the long-term mental health and psychosocial well-being of the affected population. ... One of the priorities in emergencies is thus to protect and improve people’s mental health and psychosocial well-being*" (Norris et al., 2002; van Griensven et al., 2006; Duckworth, 1986; Bundesamt f. Bevölkerungsschutz und Katastrophenhilfe, 2011).

4.2. Intervention Personnel

Being a First Responder is a stressful experience, both in physiological and in psychological terms (Bundesamt f. Bevölkerungsschutz und Katastrophenhilfe, 2011). Psychological problems appear not only during an intervention, but often result in long lasting suffering.

4.3. Evacuation

Having to leave one’s home place is a highly traumatic experience and thus the source of many psychological problems.

5. Supportive Information and Communication Technologies

Modern Information and Communication Technologies (ICT) are able to support and improve the reaction to disasters in numerous ways.

5.1. Communication

Disasters tend to destroy large portions of our communication networks. Chroust (2008) discusses different communication channels and their substitutability in case of an emergency. The generation of timely, adequate warnings is of key importance (Skrbek & Kviz, 2010) (Tierney et al., 2001, chapter 3).

5.2. Training

In order to utilize available state-of-the-art tools adequate training is of high importance in order to operate the equipment, to make the correct interpretations of the results, to draw the correct conclusions, and to initiate the appropriate reactions. Modern Information and Communication Technologies (ICT) can today provide training environments with simulated and mixed scenarios (Mixed and Augmented Reality) which are flexible and cost effective (Chroust, 2008; Chroust et al., 2009b).

5.3. Planning and Simulation

ICT is a key to effective planning, especially by simulating possible evolvement of the disaster and its consequences (Chroust et al., 2009b; Sturm et al., 2009).

6. Summary

Today's large regional disasters call for a systemic approach for Interventions. Humans are central both as First Responders. They need training and appropriate equipment, both can be provided by modern Information and Communication Technologies. Systems Theory is able to provide models for Interventions and organizational structures.

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Socio-systemic Analysis: The Case of Costa Concordia, a Tale of Two Disasters

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Abstract: *This paper introduces core principles that define a 'socio-systemic analysis' of a disaster', with particular emphasis on the role of information, communication and decision-making, and discusses their application to the recent sinking of the Costa Concordia, concluding with some lessons learned and recommendations.*

Keywords: socio-systemic approaches; risk mitigation; citizen preparedness; Costa Concordia

Introduction: One of the characteristics of 'disasters' is that they can never be fully predicted or anticipated by classical risk appraisal techniques. In this research a 'socio-systemic approach' is proposed in the context of a 'resilience engineering' perspective, and applied to the Costa Concordia incident occurred in Italy in January 2012. The analysis identifies two distinct phases of the 'disaster': the actual collision of the ship into the reef, and the delayed emergency operation that followed. This research is highly interdisciplinary and draws from different fields, in particular socio-technical systems and networked capabilities research, and crisis management. The article is organised as follows: Part 1. Introduces the motivation and drivers for the inquiry, Part 2. discusses 'systemic nature' of disasters, with emphasis on socio-technical systems Part 3. considers the role of information flow, communication on decisions making. Part 4. Analyses evaluates the case of the Costa Concordia as two distinct phases of a disaster in the light of the model presented

1. Background and Motivation: A Tale of Two Disasters

One of the fields of application for research investigating socio-systemic failures is 'crisis management', in particular the study of ways to optimise publicly shared emergency information among agencies and members of the public, to enable informed decision making thus increasing resilience of individuals and communities. In addition to situational risks during emergencies, lack of information and poor decisions can aggravate the circumstances. When the Costa Concordia ran aground 13 of January 2012, recorded as the largest marine accident in history, occurred in the absence of adverse weather and technical failures, the delay in evacuation procedures caused loss of life, and widespread chaos and panic. The questions that drive and motivate this inquiry are:

1. Which critical factors contributed to the failures that caused loss of life

2. What lessons can be learned that can help marine operators, regulators and policy makers and passengers prevent the situation occurring again in the future?

2. The systemic nature of disasters

No clearcut definition exists for what is a disaster, an issue widely researched and debated among scholars. It can be said that a disaster occurs "at the intersection of hazard and human environment" (Lindell et al, 2008). It has been defined as a "consensus-type crisis situation where demand exceeds the capabilities" (Quarantelli), and as a "social phenomenon that occurs when a community suffers exceptional levels of disruption and loss due to natural processes or technological accidents.” (Smith & Petley). Other definitions in use include “A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources” (UNISDR) and a “situation or event which overwhelms local capacity, necessitating a request to a national or international level for external assistance”[1]. A 'systemic approach' considers and tackles 'disasters' as emergent phenomena generated by the combination (entanglement) of more than one factor, and triggered by more than one cause (concurrent or subsequent), which can include 'human' and 'socio-technical' failures. Among these, this research identifies poor information and inadequate decision chain, and overall failure to apply socio technical and networked capabilities principles to the operation of the vessel.

2.1. A socio-technical perspective

A 'systemic approach' is defined as a method or a 'lens' that considers the factors that can contribute directly or indirectly to an event in combination (Autio, 1997). The nearest to systemic approaches, and a precursor of the same, is the 'all hazard' approach (FEMA, 1996). Two perspectives help define systemic approaches in this research a) a perspective that takes into acount the combination of factors that contribute to cause or trigger a disaster and does not look exclusively for a single event or failure b) that considers the traditional disaster management cycle (mitigation, preparedness, response, recovery) as a whole resilient process rather than as discrete phases.

2.2. Ship as a socio-technical system

According to Socio-technical theory the joint optimization of social and technical resources is achieved by addressing and integrating human factor and social processes (Trist & Bamforth, 1951). The human and social aspects of a ship's organization emerge from the interaction of people and a vessel's technical systems and as the basis of navigation safety, the notion of socio-technics can be applied in the full sense in the analysis of organizational and work processes. In socio-technical theory the hierarchical chain of command tend to be decentralized and acquire the characteristic of “responsible autonomy”, where small groups or teams are responsible for their own internal organization and control with the primary task of establishing relationships with other groups, (Rice, 1958) designed to remove the traditional hierarchical management which is considered a burden to modern ship´s organizations and is based on two basic principles: the interaction of human and technical factors which, depending on the degree of compliance, create conditions for efficient or inefficient organization, and the optimization of each element individually (human or technical), which independently can increase the possibility of unpredictable and unusual relationships, and lead to a drop in the efficiency of organizational system as a whole (Bielić et al., 2010). In addition two further principles characterise STS: adapablity, where “outcomes or ‘effects’ were more important than activities or the precise means by which those effects were achieved” and meaninfgulness of tasks: eaningfulness arises out of a focus on the group, from responsible autonomy and from adaptability, linking jointly optimised sociotechnical systems to a number of ‘core job characteristics’ (Hackman & Oldman, 1980). Contemporary sociotechnical theory is converging with 'networked enabled capabilities' (NEC) research, as the interest in the opportunities and issues raised by information technology and the internet is central to a contemporary STS theory (Walker et al., 2007).

[1] http://ec.europa.eu/agriculture/analysis/external/insurance/definitions_en.pdf

3. The role of information and communication in socio-technical risk analysis

Socio Technical Systems (STS) theory revolves around the study of two interrelated dimensions: the human/social factors and the technological ones (Walker et al., 2007). Contemporary technological issues however spawn into sophisticated multilevel dimensions, where information technology plays a central role, and as information technologies in turn become reliant on knowledge bases, advances in cognitive science influence not only the architectures of the technical systems themselves, but also the decision making patterns and organisational structures that emerge. A third dimension has in the last decade become part of STS models: knowledge (Mitchell Nault, 2003). In consideration of the convergence of STS and NEC, and the increasing importance of the role of information and knowledge networks to support non-hierarchical decision making to increase efficiency of operations, the case of Costa Concordia is analysed with emphasis on the role of new communication networks such as social media.

4. The case of Costa Concordia, systemic analysis of a disaster

On 13 January 2012 the Costa Concordia, a cruise ship owned and operated by Costa Cruises, a subsidiary of American-British Carnival Corporation, hit a rock off the shore of Isola del Giglio, near the western coast of Italy, opening a 70 meters long hole on her side. The series of events that led to the collision of the ship with the notoriously dangerous reef in relatively shallow waters, have been caused by a tragic and highly entangled chain of events that overall caused the disaster. Even of more serious consequence than the collision itself, the delay to start evacuation procedures led to the endangering of all the passengers and crew on board, and caused loss of life, and widespread panic and increased danger for passengers, which found themselves in a critical situation. The 'real' disaster was the way the emergency procedure was operated and managed, in disregard of all good contemporary practices. A criminal investigation, at the time of writing, is underway to assess the responsibilities of the disaster, and likely to go on for a long time, taking into account the very large number of witnesses, and the complex level of analysis. Key evidence including the navigational records are still privileged and currently being examined by the judiciary. For the purpose of this paper the analysis of information provided by witnesses accounts and parties involved, such as the suppliers of navigational charts called in question by the Captain of the vessel Mr Schettino who blamed an uncharted rock for the incident. No single approach nor method exists capable of supporting the analysis of this incident in its entire complexity, multidimensions and facets. This inquiry therefore is currently limited in scope, and is confined to a subset of facts known to date. The conclusions and recommendations contains herewith are therefore to be considered 'ad interim' and subject to ongoing updates, as facts emerge.

4.1. Sources of Public Knowledge in the case of the Costa Concordia

In order to carry out a systemic analysis, it is necessary to access primary data and information pertaining to the events, and series of events, under investigation. At the time of writing, the contents of the ship's black box has been acquired by the judiciary in charge of the criminal investigation, and it is confidential and not publicly available. Live ship tracking website Marine Traffic[2] shows the track of the cruise ship Costa Concordia just before it crashed into the island of Giglio in the Mediterranean Sea.

[2] http://www.marinetraffic.com/ais/default.aspx?zoom=9&oldmmsi=247158500&olddate=1/13/2012%208:21:00%20PM

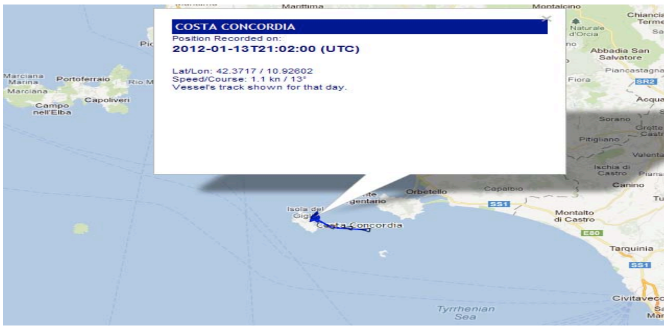

Illustration 1: Map from Maritime Traffic

Vessels over 299GT are required by International Maritime Regulations to carry an AIS transponder on board, to broadcast open data on position, speed and course, among some other static information, such as the vessel's name, dimensions and voyage details. Thanks to this AIS data there are now a lot of Google Maps mashups showing the real-time positions of ships around the world. According to Marine Traffic data, at a distance 7-8 nautical miles from the Channel between the Giglio island and the mainland of Italy the ship made a course alteration of 20 degrees to port side, to carry out what is known as 'close berth' to the Island, and hit the reef. [3]At this stage on board activities were disrupted by the strong effect of the impact and according to passengers report, the dining tables turned and the vessel was plunged into darkness, Passengers reports became immediately publicly available via the use of social media networks. A first message was posted on Facebook by a relative of a the captain, to inform the public to watch out that the ship was going to come close to island for a ritual greeting. Shortly after the collision with the rock, a passenger posted a message on twitter saying that the ship had stopped due to some kind of electrical failure. It is via the analysis of social media networks posts, that some facts relating to the events began to emerge in real time. At the time of writing, in addition to maritime traffic data, the main source of information for what happened have been social media websites, where passengers and families posted stories photos and videos, which complemented and sometimes contradicted information released by public information channels. The rest of this paper analyses and triangulates information from various sources, to attempt to answer the questions in Section 1.

5. Preliminary findings

Initial analysis of the facts gathered at the time of writing this abstract, leads to the following preliminary conclusions:

- The loss of life (28 deaths so far) although limited given the high number of people at risk (over 4000) could have been avoided altogether, had the emergency and evacuation procedures started as soon as the incident took place, or within a reasonable time frame. It was hours however before evacuation was started, without the official order from the commander but due to the personal initiative of another official.
- In addition to official procedures, ships and crew observe a series of unofficial procedures (such as close berth approaches to shore) To what extent the unofficial practices are spread is unknown and not documented. It is also not clear what role the operating company plays in informally allowing, or even expecting and possibly demanding, unofficial practices to be carried out via some form of internal, unspoken peer pressure from senior officials
- Factors that may have contributed to the delay in launching the emergency signal after collision were: pressure from the operating company to minimize the incident to reduce economic damage

[3] http://www.seanews.com.tr/article/ACCIDENTS/74284/Costa-Concordia-accident-navigational-error/

and consequences, including possibly in relation to insurance policy and clauses, a cultural norm that delays alerting the public of an emergency to avoid causing panic

- This incident shows how deviation from standard operational procedures can increase risk and even cause loss of life - in the case of the Captain changing arbitrarily the navigational course - but also it can contain risk and prevent the loss of life - in the case when another official decided to start evacuating the ship without the official order from the Commander to do so.

The rest of this paper presents and expands on the arguments introduced in this abstract, and lays the foundation for further work.

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A Systemic Comparative Analysis of Japan 2011 and Chile 2010 Earthquakes-Tsunamis

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Abstract: *Why a similar magnitude earthquake-tsunami produces so different effects in different places? A possible explanation is that the geographical, socio- economic, demographic and cultural conditions are different, and so are their vulnerability levels. The purpose of this paper is to analyze, systemically, the reasons for these differences, and draw some conclusions and recommendations.*

Keywords: Chile; disasters; earthquakes; Fukushima; Japan; nuclear plants; risks; prevention; Tsunamis

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1. Japan Earthquake-Tsunami (2011)

A very big earthquake (9.0 Mw) and tsunami occurred in Japan on Friday 11/03/2011 at 14:46:23, local time, with the following consequences: 15.836 dead persons, 3.650 disappeared, 5.948 wounded and about 50,000 evacuated people who lived near the Fukushima nuclear power plant (0.03% of the national population). The seismic alarm worked well, warning one minute in advance, which is believed saved many people.

In Japan there were serious mistakes that caused that the Fukushima nuclear plant had a very dangerous radioactive leak, equivalent to that of Chernobyl 1986, and make necessary to relocate nearly 50,000 people who lived in a 20 km radius of the nuclear plant. There were failures in the design, which did not foresee a tsunami of such a magnitude, and in the post-tsunami operation, because there were no previsions of what to do in case of failure of the cooling pumps.

The tsunami caused more damage than the earthquake itself, as it generated waves up to 40 m high in some places, which caused many dead or missing people, and the destruction of homes, buildings and physical infrastructure.

The economic impact was very high, estimated equivalent to 3% of GDP in Japan, (around 182.000 million USD). However, the economic and technological strength of Japan goes ahead, and it is expected that its economy will recover in a few years.

2. Chile Earthquake-Tsunami (2010)

Another very high earthquake (8.8 Mw) and tsunami occurred in Chile on Saturday 27/02/2010, at 3:43, local time, with the following consequences: 525 dead persons and 25 missing people. The tsunami damaged 500,000 homes which resulted in 2 million displaced people (10% of the population). Economic losses are estimated at 30.000 million USD (15% of GDP).

In Chile there was a fatal error: the President Michelle Bachelet announced that there were not risk of a tsunami, for people not to worry, but the Tsunami occurred and caused much more damage than the earthquake itself.

As the economic damage was proportionately larger, Chile will take several years longer than Japan to recover from this disaster.

3. A systemic comparative Analysis

Table 1 shows some important characteristics of both Japan and Chilean Seism-Tsunamis from where we can extract some conclusions.

The Chile´s earthquake magnitude was 12 % smaller than in Japan´s, but the quantity of dead and missed persons was 35 times bigger in Japan due to the great tsunami generated, and the amount persons near the coast line, even though, the relative amount (%) of mortalities was 5 times bigger in Japan,

The economic losses in Japan were 30 times bigger than In Chile, but due to the great industrial and economic development of Japan, the relative (%) economic impact of Chilean Earthquake is 3 times bigger than in Japan. We can predict that it will take more time in Chile to recover than in Japan.

Table 1: A systemic comparative analysis of Chile 2010 and Japan 2011 Earthquakes -Tsunamis.

Concept	Chile (2010)	Japan (2011)
Date	**27/02**	**11/03**
Day / local time	Saturday / 3:43	Friday / 14:46
Earthquake Magnitude (MW)	**8.8**	**9.00**
Million Ton of TNT equivalent	210	240
Dead and Disappeared Persons	**550**	**18,920**
% of total national population	**0.003**	**0.015**
Economic Losses (Million USD)	**30,000**	**182,000**
% of GNP	**15**	**5**

Both countries were relatively well prepared for the hazards because, previously, they have had some important earthquakes and learned from these experiences: In Chile- Valdivia, 22/05/1960, magnitude 9.5 Mw, the greatest recorded earthquake in modern times, and in Japan, Kobe-Hanshin, 17/01/1995, A magnitude 7.1Mw earthquake that destroyed several bridges.

Both Chilean and Japanese tragedies show that all the preparation for reducing the vulnerability of these countries has not been sufficient, and that mucho more should be done in the future.

4. Conclusions and Recommendations

Preliminary conclusions and recommendations of this work are the following:

1- Tsunamis generally cause more damage than the earthquakes that is linked to them;
2- It is important to be prepared for the risk of disasters caused by earthquakes- tsunamis, for example, do not build homes in areas at risk, or if built, it is recommended to have anti-seismic structures and a wall that protects from large waves;
3- It is recommended not to build nuclear power plants in high-risk areas, such as coastlines or near large towns, and if they are constructed, take provisions for design and construction to withstand the onslaught of big waves;

4- Nuclear power plants remain as a very dangerous option, which must be handled with extreme care or preferably seek other safer power generation options; and
5- We all should learn from these lessons, to avoid making the same mistakes, both, in the same countries analyzed, or in other countries with similar risks.

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Systems Design Analysis of Stranded Commuters Behaviors

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Abstract: *It is impossible to have a single, correct set of facts about the stranded commuters in a large-scale transport disruption such as the Tohoku Earthquake. Instead we could collect multiple facts from multiple viewpoints about the situation. Hence, stranded commuter behavior studies will take a social systems design standpoint, one seeks plausible and acceptable, local answer. The author tries to find systematic decision-making and behavioral patterns of stranded commuters among the three incidents of 2004 minor earthquake, 2010 Iceland volcanic eruption, and 2011 Tohoku Earthquake.*

Keywords: stranded commuters behavior; 2011 Tohoku Earthquake; systems design analysis, damage reduction

1. Systems Design Nature of Stranded Commuters Behavior Studies

Previous study on disaster prevension by Yamori and Atsumi et al. (2011) argues that it is impossible to have a single, correct set of facts about the stranded commuters in a large-scale transport disruption such as the Tohoku Earthquake. Instead we could collect multiple facts from multiple viewpoints about the situation. Hence, stranded commuter behavior studies will take a social systems design standpoint, rather than statistically significant hypotheses-testing research.

2. Tohoku Earthquake Case: Estimated 5.15 Million Were Stranded in Tokyo

When the Tohoku Earthquake occurred at 14:46 on March 11, 2011, Tokyo was not hit by it except some in small areas. Yet, the Tokyo transportation system was severely affected by it. Roughly estimated 5.15 million commuters in the greater Tokyo area were stranded that day. Many walked home, while some stayed at their company, school, etc. This kind of a major transport disruption was never anticipated in the greater Tokyo area; hence, neither the railway/subway companies, companies, nor schools were prepared for it.

3. Previous Studies Related to Stranded Commuters

3.1. Decision-Making Principles under Uncertain Conditions

Sekiya (2008) emphasizes a proactive principle beforehand: (1) If you are in doubt, act now. “Wait until the situation is clear” is a wrong attitude; (2) Act for the worst situation. Do not hope for situational improvement; and (3) Over-reacting is allowed but overlooking.

3.2. Action Research on Disaster Prevention and Damage Reduction

In a study on action research on disaster prevention by Yamori and Atsumi et al. (2011), they argue that one does not seek the universally correct answer. Rather one seeks “Plausible and Acceptable, Local Answer,” which is local rather than universal, temporary, and field-specific. Such action research needs (1) inter-locality: comparison between multiple locations for understanding a certain location, in comparison with other locations; and (2) inter-generationality: comparison between different times of the same location. (*Ibid.,* pp. 8-10)

Science of disaster-prevention and damage reduction is narrative design in which one conducts interpretations of the situation from various angles, rather than seeking universal lows on disasters (*Ibid.,* p. 19). When we conduct such narrative science of disaster-prevention and damage, we seek pragmatic and pluralistic interpretations that could bring in revolutions/evolutions in disaster rescues and recoveries (*Ibid.*, p. 11).

3.3. Studies in Architecture and Civil Engineering on Disaster Risk Management

Architectural studies by U and Yamada (2011), studies in civil engineering (2012), and MLITT council report (2011) are oriented more toward suggestions and proposals for damage reduction in the future, rather than conducting hypothesis-testing type research found in social science literature.

3.4. Systems Analysis of Systems Design Nature of Earthquake Impact Studies

Figure 1 summarizes the systems design nature of stranded commuter behaviors studies, rather than statistically valid hypothesis-testing type nature. Researchers could be a part of action research, proposing possible improvement measures for future natural and other crises.

3.5. Systems Analysis of Stranded Commuters Behavior after Tohoku Earthquake

Figure 2 summarizes the findings on the behaviors of the stranded commuters in the greater Tokyo area after the Tohoku Earthquake, based on the facts gathered as indicated in the previous sections. On that day, there were TV reportings of a very large number of commuters walking home. However, a study after the Earthquake found out that most of those who tried to walk home had commuting distances of about 14 km or less, while most of those who chose to stay at their companies, and schools tend to have longer commuting distances. One reason for those who tried to go home on that say was their inability to make contacts with their families.

One study finds that there seemed to be two cut-off points for the stranded commuters' decision of going home or staying overnight where they were: (1) Around 18:00 when East Japan Railway announced shutdown of their greater-Tokyo operations for the day; and (2) Around 21:00 for going home within reasonable time or staying overnight for the day.

Also, this research found two major reasons for the going-home/staying overnight decisions: (1) Inability to contact their homes, rather than actual damages; and (2) Whether the distance between the commuter's work place/school and home is within the walking range.

Figure 1 shows the systems design nature of research on earthquake impacts on stranded commuters. We could receive first-hand information on those affected by a major earthquake, with various inputs from multiple viewpoints, rather than statistically significant data on those stranded commuters.

4. More Inputs for Stranded Commuters Behavior

The author conducted a survey on the March 11 stranded commuter difficulties with our Shibaura Institute of Technology MOT faculty, graduate students and alumni, and conducts a systems analysis to identify their decision-making and behavioral patterns. Study on the survey data will be presented at the EMCSR.

The author was stranded at the Vienna International Airport on April 15, 2010, for the Iceland volcanic eruption, right after the conclusion of the IFSR Systems Conversation in Pernegg, Austria. Also, the author was stranded aboard a Japan rail long-distance train in the long, Tan-na tunnel near Atami, because of a considerably large earthquake in Tokyo around 2004.

The author intends to combine the facts at these two additional transport disruptions, and try to identify systematic decision-making and behavioral patterns among the three incidents. The combined systems analysis of the three incidents will be shown at the EMCSR conference.

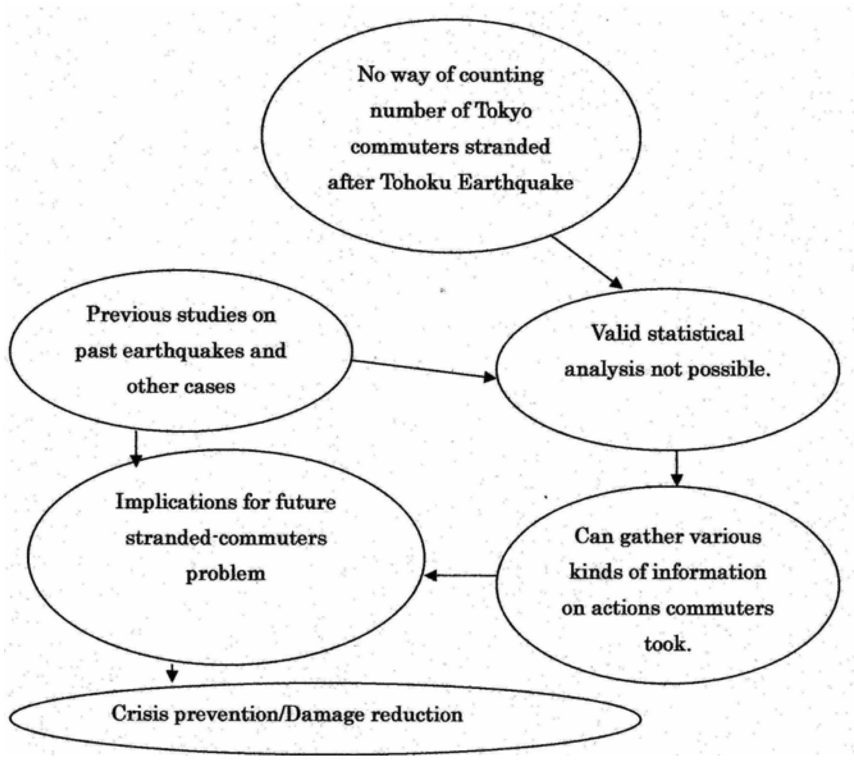

Figure 1: Systems Design Nature of Earthquake Impact Studies

5. Implications

Two Implications for stranded commuters are proposed from this study:

(1) : A. The more one has previous transport disruption experience, and

B. The more information one has on the current transport condition,

the quicker one makes a decision between going home and staying where one is.

(2) : A. The more information one has on the current transport condition, and,

B. The more information one has about the family's safety,

the more one prefers staying overnight at a shelter, rather than trying to return home.

A natural disaster and other incidents could cause commuters stranded. Since each situation is unique, and often unexpected, those affected have to make a series of decisions on whether to going home or stay where they are, under great uncertainty. For that, there are several precautions one can take; (1) Carry minimum supply of essential items for living, such as water, emergency foods, maps, medications, etc., and, (2) Be equipped with a sort of meta-level information gathering and decision making system under uncertainty within oneself. More options, wider systems perspective.

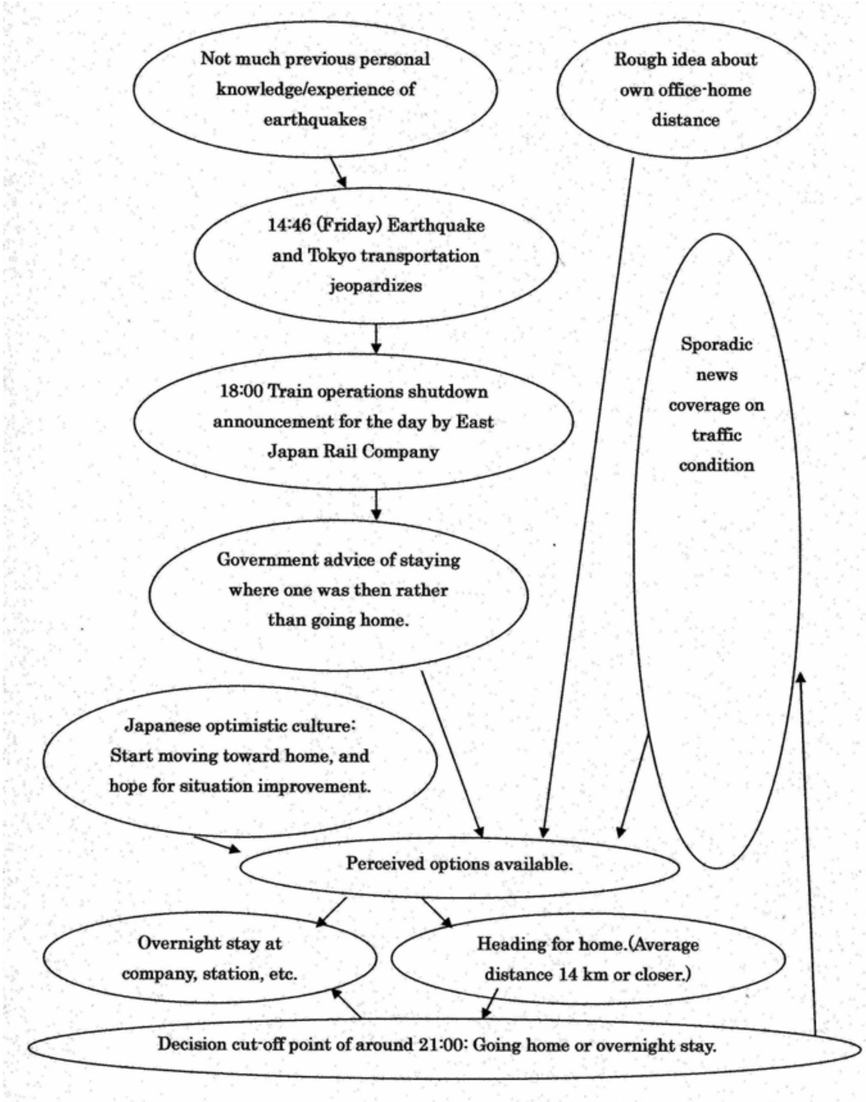

Figure 2: Systems Analysis of Tokyo Stranded Commuters after Tohoku Earthquake

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Social Media Applications in Crisis Interaction

Background, models, strategies, opportunities and potential risks of using social media in crisis

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Abstract: *Social Media Applications are increasingly widespread in modern societies. Internet use and mobile access to information, social networks, entertainment and services are and will be subject to rapid growth and create an essential source for so called "Social Media Analyses" (SMA), which allow to systematically monitor and analyse user generated contents for different purposes. Given this prominence Social Media have reached in different fields, we identify a crucial importance to promote the application of Social Media services for effective disaster prevention and preparation, faster and interactive investigation and tracing processes via strategic information search and inclusion of the public, better crisis management as well as positive image development. Based on current possibilities and evolving practices of Social Media usage as a means of community participation, this paper develops ideas for a future use of Social Media in disaster management and general crisis mitigation. The opportunities which are meant to be identified will be weighed up against potential risks and weaknesses of this approach.*

Keywords: social media analytics; multilevel crisis interaction; crisis dynamics; multi media integration; vulnerability prevention; crisis communication

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She graduated with distinction at the philosophic faculty of the University of Vienna, is studying Psychology and Gender Studies and participated in trainings on social sciences, project management, adult education and emergency medical services. At the Research Institute of the Red Cross in Vienna, she could gain professional experience in leading and contributing to national and international projects focusing on security research, ICT & ageing and eHealth. In her position as PR-consultant for NGOs and business clients she gathered experience regarding social media, communication issues and intervention design.

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Strategies for Regional Disasters

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Abstract: *Disasters are best prevented but climate change is well and truly upon us as we saw with the accelerating rate of events in 2010-2011. Climatologists tell us that with a rapid reduction of emissions, we can still avoid the worst climate change but increasing disasters are inevitable and we must prepare.*

Therefore, this paper presents a design of coordinated events to achieve strategies for both mitigation and disaster preparedness. The design is based on the jurisdiction of the Australian Capital Territory (ACT) which comprises Canberra, the national capital and a hinterland of small hamlets and dense bush or wilderness. There are several separate emergency services such as the standard ones of Police, Fire Brigade and Ambulance but also including the state emergency service and the Rural Fire Service. These latter consist of a small number of professional officers and a large number of highly trained volunteers clustered around geographically strategic depots.

In addition, all households are supposed to have bushfire plans but as we saw in the firestorm that devastated southern Canberra in January 2003, there were failures at all levels of the hierarchical bureaucratic system and many households either did not have plans or did not implement them in time. Only a well prepared and coherent community response where the combined emergency services and the general community are ready to, and know how to, work together can prevent the level of destruction we witnessed in 2003. This applies regardless of the nature of the disaster.

The paper describes the theory behind the design and explains its shape. Open Systems Theory (OST) has been used in Australia and elsewhere as the basis for such large scale regional efforts since 1970 and two major methods have evolved from integrated theory and practice. These major methods are the Search Conference for strategic planning and the Participative Design Workshop for organizational design and redesign. These methods are supplemented by Unique Designs which are custom designed from the theory to meet any other purpose.

The first phase of the design takes place in the sub-regions including the suburbs of Canberra. Its purpose, the system that is the focus of the Search, is to provide the citizens of these sub-regions an opportunity to devise their own unique plans for improving their sustainability (mitigation). These first round events will use the Community Reference System through which a community chooses the participants for their Search Conference such that they are a non-biased sample of the broader community that is trusted by that community to work in the interests of the whole. As the first most critical criterion for selection is a track record of being active and concerned about the community, the final list of participants will almost certainly include many from the emergency services brigades.

Participants from this first round then attend an 'integration event' in which the strategic goals from the individual sub-regional Searches are integrated and sorted by the location of responsibility for their implementation. Some goals will clearly be the responsibility of the individual sub-regions or all sub-regions: others will be the responsibility of the ACT government.

Those that are the responsibility of the ACT government will be passed over to them. Those that are the responsibility of all sub-regions will be implemented by all sub-regions. Those that unique to a sub-region will be implemented only by that sub-region. After the integration event, the Searches reconvene to make their action plans and start implementing them. The groups formed in this first phase will also then be available as the basis of a community response when disasters hit.

The second round of events focuses on disaster preparedness. Here the participants will consist of heterogeneous samples of members of the various emergency services again chosen by their own members through the Community Reference System. The system of the Searches is an effective, coordinated disaster response so the most desirable future of disaster response will form a comprehensive set of strategic goals the emergency services need to collectively implement. Their will be a similar integration with various strategic goals being farmed out to the relevant services and levels thereof, for action planning and implementation.

Both rounds of Search Conferences and integrations will be followed by a modified Participative Design Workshop in which the participants design a structure based on cooperative groups so that the energy and motivation generated in the Searches will be continued into the implementation phase.

For the emergency services, this becomes a particular focus. At the moment, all services are organized on the first genotypical design principle which yields a dominant hierarchy or bureaucratic structure with all its proven faults and maladaptive consequences. As we saw in the 2003 disaster, these structures do not only fail in various critical ways, they can positively inhibit a fast, constructive response by volunteers and citizens alike.

All the emergency services will need a series of Participative Design Workshops in which they redesign their individual service into one based on the second design principle that produces cooperation rather than competition so that they may continue their collaboration with the general community to the ultimate benefit of all.

The purpose of the design is to not only to improve the effectiveness of disaster responsiveness but to weld the community of the ACT into a well prepared, cooperative and coherent force that can better enhance its sustainability, reduce its vulnerability and better respond to our inevitable future.

Keywords: climate change; genotypical design principles; open systems theory; Participative Design Workshop; Search Conference; Unique Designs

About the Author

Merrelyn Emery

Merrelyn Emery obtained her first class honours degree in psychology from the University of New England in 1964 and her PhD in marketing from the University of New South Wales in 1986. She has worked in psychology, education research and continuing education, mainly at the Australian National University. From 1970 she worked with Fred Emery specifically to develop open systems theory and is currently an adjunct professor in Applied Human Sciences at Concordia University. She has published numerous articles together with a host of institutional research reports as well as 15 books, the latest of which is The Future of Schools. She is currently working on several research projects including analysing data on social change since 1979, practical strategies for organizations and communities to more effectively address the causes and effects of climate change, and documenting the need for science in general to move from closed, reductionist frameworks to the reality of phenomena as open systems.

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The South American Integration and Cooperation in Natural Disasters

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Abstract: *The South American integration process represented by the Union of South American Nations (UNASUR), constitutional support in most of the states, is the ability to take complex and multidimensional challenges of these times better off. The South American Defense Council, an UNASUR dependent technical body, provides the region as a zone of peace, purpose designed to build an identity on defense, natural disaster cooperation and consensus to strengthen regional cooperation and contribute to the purposes that pursue this integration effort. Venezuela, UNASUR member country provides a framework of legal action as the National System of Civil Protection and Disaster Management (2001), National Security (2002) and Integrated Risk Management Natural and Technological Partner (2009), in which envisions a system of civil protection under the constitutional standards of responsibility and safety. These three devices are analyzed from a systematic perspective.*

Keywords: UNASUR; the South American Defense Council; integration; natural disasters; security

1. Union of South American Nations (UNASUR)

This Regional integration processes have been present in the imagination of Latin American countries. The Liberator Simon Bolivar was the precursor to the project of Greater Colombia (in the nineteenth century), first effort for integrating the new world, projected this hope to the nations located on the south side of “Rio Grande”. The need to address in a better position demanding times of globalization / internationalization in the rescue of an emerging position of greater independence from the dominant positions of central processes, economic and political world, require a common position and the organization Latin American countries, to generate an economic and geopolitical ideological autonomy. UNASUR is composed of twelve South American countries: Argentina, Bolivia, Brazil, Colombia, Chile, Ecuador, Guyana, Peru, Paraguay, Suriname, Uruguay, and Venezuela. The population of countries corresponds to 361 million people spread across 17 million km^2 (Cuevas, 2011, p.34).

2. The South American Defense Council as an agency of UNASUR

The democratic system prevailing in the region favors the stability and continuity of the integration project and the Council of Defense must be a significant entity in the scheme. The overall defense of the region as a set of systems, methods, measures and actions in order to safeguard the independence, freedom, democracy, sovereignty, territorial integrity and the development of the region, where in addition to the dimension that includes territories and geographical spaces, citizens, considers a system of civil protection and social risk management as a key variable in the overall defense, where the state in conjunction with this foster private initiative for the comprehensive development, sustainable and productive with objective of ensuring the participation of society and get more welfare of the population. The South American Defense Council, predicted in its 2011 annual plan, a line of action referred to the Military Cooperation and Humanitarian Action. Table 1 presents the three activities to be developed in 2011 related to capacity building in disaster preparedness.

Table 1: Military Cooperation and Humanitarian Action in UNASUR. Action Plan 2010-2011.

Activity	State responsible/ jointly responsible(s)
Perform an exercise in the letter about the natural disasters that will take place in Punta Callao in the first half of December 2010.	Peru
Consolidate inventory of defense capabilities to support countries provide humanitarian actions	Brazil
Propose mechanisms for use of the inventory of the defense capabilities of Member States in case of natural disasters.	Brazil/ Chile, Peru, Colombia, Venezuela

The inventory of defense capabilities to support humanitarian action is an important issue to be developed by the South American Defense Council, as it will meet the operational possibilities of each member state and facilitate the development of plans to run defense capabilities in the case of disasters. This instance must define the terms of integration so that states adapt their internal regulations and act in synchronization with the reality of each country in the region and with other integration schemes as the Andean Community of Nations, the ALBA-TCP and MERCOSUR. At present, some members of the UNASUR countries: Argentina, Bolivia, Brazil, Chile, Ecuador and Uruguay, assist Haiti unilaterally by the earthquake of 2010, participating through Stabilization Mission in Haiti United Nations (MINUTASH) originally established by the Security Council of UN, contributing troops and police officers.

Maria Emma Mejia, General Secretary of UNASUR (2011-2012), before this experience of MINUSTAH, said that the armies of the region can work together in the event of natural disasters. Gualdoni (2011): "The experience of the multinational force in Haiti, where the region has deployed nearly 6,000 troops, is the best example that our militaries can do a great job together when addressing natural disasters". In May 2011, the Republic of Peru through the Minister of Defense, on the issue of defense against natural disasters, raised the availability of a 'fleet ocean' because 'are often not allowed to enter or air land 'to the affected area and nations must have immediate relief alternatives. He also said that the 12 countries of UNASUR are preparing boxes of practice with the likelihood of emergencies in the region.

South America is highly vulnerable to seismic events, floods, landslides, capable of causing heavy human and material losses (EFE, 2011). The South American Defense Council should formulate their action plans taking into account the pattern of development followed by the South American countries with high rates of poverty, unemployment, socio-economic exclusion and environmental degradation as determinants of high vulnerability and therefore risk to natural hazards.

3. Civil Protection Systems and Risk Management Social

Venezuela, an UNASUR member state, has provided regular laws dealing with civil protection system and the participation of public and private institutions with civil society in the event of natural disasters, according to the constitutional standards of responsibility and safety, including the National Civil Protection and Disaster Management (2001) responsible for creating the Organization of Civil Protection and Disaster Management at National Act, State and Municipal (guaranteeing to the last ones the concurrent jurisdiction with National Power, respecting the powers that are proper) and regulates the participation of both volunteer groups, such as citizenship, the civil protection and disaster management. The National Security Law (2002), advanced law that regulates comprehensively the security, civil protection system and social risk management and the Integral Management of Natural and Technological Hazards Partner Law (2009), leading act that determines the application of national policy comprehensive risk management of natural and technological partner that cuts across all levels of public power and private individuals.

The National Security Act (2002), stated in Article 23, the security organs: "according to the provisions of the Constitution and laws, the National Executive will organize a uniformed national police, a body of scientific research, Criminal and a fire brigade and civil protection organization will respond to emergencies and disasters, which, without prejudice to the specific functions assigned to it, must work together for the purpose of ensuring the preservation of internal order " The Article 24 defines the civil protection system as: "a social risk management in which they act different public bodies at national, state and municipal levels, with the participation of society, and extends from the State planning to specific processes with a view to reducing vulnerability to natural order of events, technical and social". It is an integral concept of responsible manner involving civil society, and forces it to participate actively to the vulnerability of unanticipated events caused by nature. The South American Defense Council, should focus on unified criteria among the states in the region to give effect to future policies that must be implemented to provide efficient support who requires it due to nature effects.

4. Conclusions

The South American States have in common the particular vulnerability of the region where seismic events may occur, as floods, landslides, and other natural disasters that could cause severe human and economic losses that require the timely cooperation of neighboring states. The South American Defense Council as an agency of UNASUR, engaged in developing inventory capabilities and mechanisms to implement them. States as Venezuela, made his contribution through various laws as: National Security (2002), National Civil Protection and Disaster (2001), and Integrated Socio-Natural and Technological Risk (2009) which establishes the responsibility in civil protection, social management and public safety risk.

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Risk Management and Regional Distribution of Disasters

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Abstract: *Risk is defined as "disaster damage" times "its occurrence probability. Based upon the risk boundary which indicates the toughness against disasters, risk diagram and risk matrix are proposed and used for systemic approaches to regional disasters. Risk diagrams are closely related to Zipf's law which characterizes distribution and concentration of hazards, for an example, earthquakes. Finally, PDCA review cycles are introduced for action programs of systemic approaches to regional disasters.*

Keywords: regional disasters; damage, hazards; risk management; Zipf's law; Earthquake; PDCA

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1. Risk management against regional disasters

1.1. Risk and crisis management against disasters (Figure-1)

In general, risk management is defined to be the preparations and exercises before disasters, mainly for the purpose of risk minimizing

On the other hand, crisis management is defined to be the quick behaviors and responses when emergency happens, mainly for the safety and security of the people against the contingency. The contingency occurs by natural hazards or human errors. The risk managements are conducted as follows; 1) hazards analysis, 2) risk assessment (risk analysis and risk rating), 3) risk control.

1.2. Risk Diagram and risk boundary

Fig-1 illustrates risk diagram, in which the risk boundary is shown by a curve of X*Y=c (constant).

The risk boundary is an important rating scale to risk management against disaster. When c value is small enough, risk is identified to be small and safe, reversely c value is large, then risk is identified to be large and crucial. In usual, the risk boundary is specified by the authorities associated with the codes through public acceptance.

1.3. Risk zones and regional disasters (Figure-2)

When the risk is in the areas below the risk boundary curve X*Y=c, the risk is considered to be safe so that it is built-in with maintenance-free, on the other hand, when the risk is in the areas over the risk boundary, the risk is considered to be dangerous so that it should be revised and modified for safety. The regional damages are classified into four categories, A, B, C and D (Figure-2). For each level, risk management and controls are considered to a certain extent for more considerable safety and serviceability.

1.4. Regional disasters and risk controls

When the damages are considered to be serious once happened, the protections and preventions are installed against failures. When they are considered to be small enough, the reductions and distributions of the effects are considered as the mitigation programs. The risk control methods for A, B, C and D (Figure-2) are as follows:

1) Risk built-in: they are allowed to be maintenance-free.
2) Risk reduction: they are strengthened and protected against failures.
3) Risk avoidance: the projects are rejected and eliminated.
4) Risk transfer: they are guaranteed and covered by the insurance.

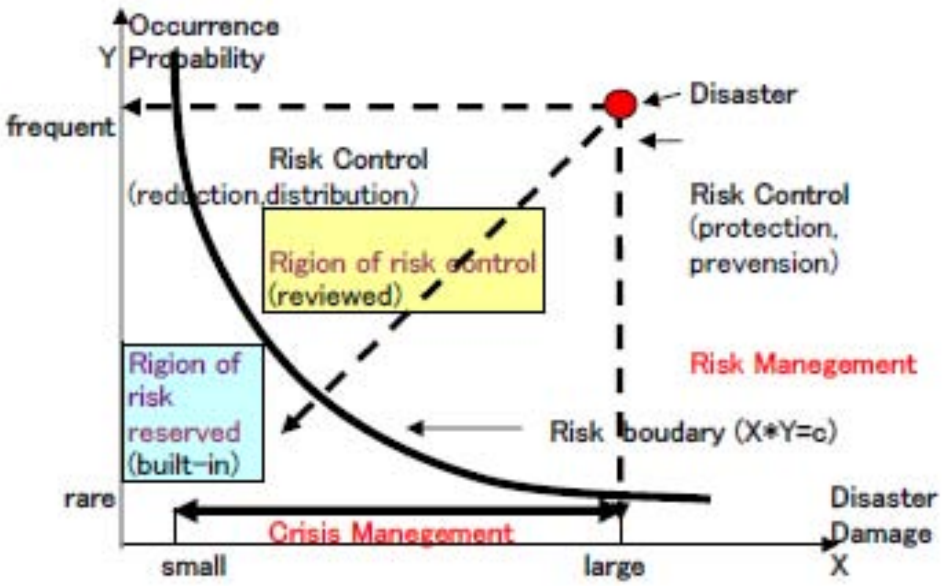
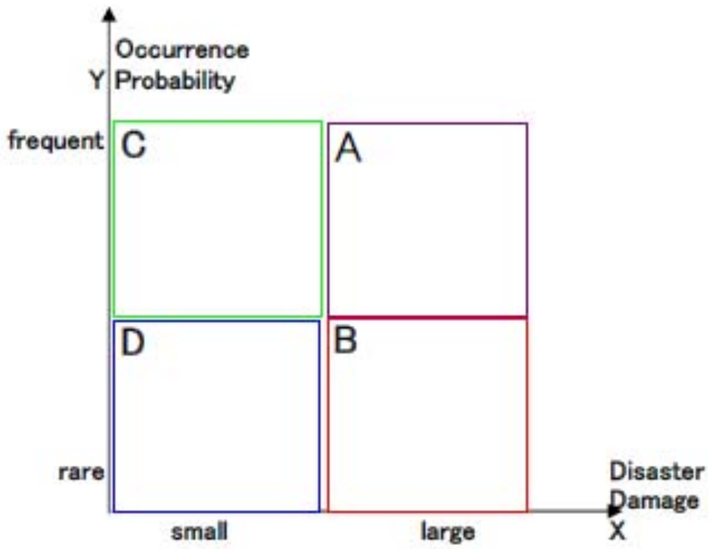


Figure-1 Risk Diagram(Occurrence-disaster damage)



Region (hazards)	Risk manegement and control
A (EQ)	1) (large damage)*(frequent occurrence probability) zone 2)high priority of risk controls against severe damage
B (fire)	1) (large damage)*(rare occrrence probability) zone 2)next priority of risk controls by transfer or risk built-in.
C (traffic)	1) (small damage)*(frequent occrrence probability) zone 2) daily matters which often occerred without control
D (work)	1)(small damage)*(rare occrrence probability) zone 2) risk built-in with maintenance-free

Figure-2 Risk Matrix (Risk frame)

2. Distribution and concentration of disasters: Example (Earthquakes)

2.1. Distribution and concentration rule: Zipf's Law by Zeta function

Based upon the many types of data studied in the physical and social science, an empirical law is formulated using mathematical statics of a Zipf distribution. The Zipf's law is available for estimate of distribution and concentration of disasters. The formulas of Zipf's law are as follow:

$F(k,s,N)=(1/k^s)/\Sigma(1/n^s), n=1,2, \ ,N$ (1)

When $s=1, F=(1/k)/(\Sigma(1/n)=(1/k)/SUM$, F is proportional to 1/N (2)

In human languages, word frequencies have a very heavy-tailed distribution, and can be modeled reasonably well by a Zipf distribution of equation (2), where SUM=10 in the English case (the top 4 words of the most use in English are **the (1/10**), **of (1/20**), **and (1/30)** and **to (1/40)**).

2.2. Damages of the earth by the earthquakes

It is said that the crack lengths of the undergrounds by the earthquakes are in sequence order due to Zipf's law. When the longest crack length is assumed to be 1, next following sequence order of sizes becomes to be 1/2, 1/3, 1/4, 1/N, where N is ranking of the crack length. The regional magnitudes of the fractures and cracks are due to this experienced theory, locally and globally.

3. System Program: Plan, Do, Check and Act by deducing and inducing processes

PDCA (Plan, Do, Check, Act) cycles are available based upon ISO14000 and OHSAS18000.

1) Plan: Based upon the above principle theory, systemic approaches to regional disasters are planned and designed.
2) Do: Risk analysis and controls are conducted and prepared against hazards. The crisis managements are worked out once the emergency happens.
3) Check+Act: The reviews and acts are programmed and spiraled up by revised modes, compared with planned and results data.
4) Plan+Do go forward by deducing process with analyzing and organizing the system. Reversely, Check+Act go backward by inducing process with reviews of the system.

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Anticipatory Modeling and Simulation for Inter Regional Security

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Abstract: *The idea of anticipatory modeling and simulation with subsequent learning from the outcomes is here applied on inter regional security work. In this setting, multiactors have to both cooperate and make coordinated decisions with just partial information about each other. With help of netAgora, a net based environment for simulation, learning, and communication, the goal of training, preparedness and continuous improvement of decisions is met.*

Keywords: inter regional security; anticipatory modeling and simulation; multi layered delayed systems; learning; decision making

1. Extended Abstract

As manifested in the European FP7 research program, Security has lately become a main issue in European Research and Technical Development (RTD). Work on modeling and simulation in order to develop better preparation and training tools for handling of crisis and complex emergencies is one of the topics that, within this broad RTD area, has been pointed out as highly urgent .

Inter regional cooperation is another main issue of European concern. In this context the Cross-border program within the European Territorial Cooperation Objective has as its prime goal to foster cross-border transnational and inter regional cooperation.

So, by merging those two interests, security in cross-border regions emerges as an urgent research area from at least two European perspectives. The attractiveness, and so the potential for positive economic development, of such regions will increase as a result of better cross-border communication, cooperation, and coordination in security matters.

Focusing down on modeling and simulation, an anticipatory approach has already been demonstrated as a promising approach for handling complex spatial systems with delays (Asproth et al, 2001; Dubois and Holmberg, 2008; Holmberg, 1998). Those approaches, however, still have to be adapted to the EU context of security and cross-border preparation and training.

The purpose of this paper will hence be to increase the potential for applying anticipatory modeling and simulation for better preparation and training tools in successful cross-border inter regional security work.

Dubois and Holmberg (2006) have presented a multi-level simulation model with anticipation and delay. Though originally envisaged for a management application, the model can easily be adapted to the case of inter regional security handling.

So, according to figure 1 at the current time (t) we have direct rescue actions (r) on the operational level, preparation, training, and maintenance (p) on the tactical one, and creation (c) of new secure environments and milieus on the strategic one. Further, as the arrows in figure y indicate, the operational, tactical, and strategic actions are mutually interdependent. Energy and resources allocated on one level will be taken from the other two. One crucial security decision will hence be to find a good balance between the three levels. A simulation tool has here the potential of supporting that decision.

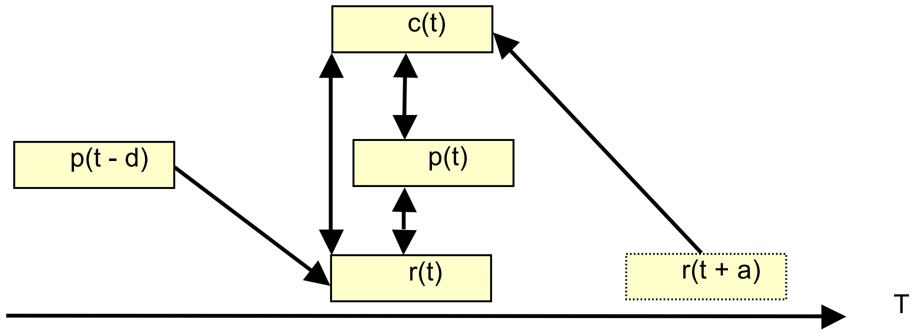

Figure 1: A multi level security system with anticipation and delay.

The situation, however, is complicated by delays. This means, for example, that an action (p) on the tactical level will not impact the operational one directly but first after a certain delay (d). Hence, the rescue (r) job you have to undertake at time (t) is to a certain degree predetermined by the preparations (p) undertaken at time (t – d).

At last, due to delays it is not appropriate to look at current rescue work (r) on the operational level when creating (c) new secure environments. That because the current operational situation (r) may never be impacted by current security increasing activities (c) on the strategic level. Instead it is necessary to look at the target security situation that is wanted at the time (t + a) the actions will have their effects on the tactical level. That means that a future security situation is anticipated by current security actions on the strategic level. Even this decision may be supported by the simulation tool we are aiming at.

The solution put forward here applies systems thinking and a multi modal design methodology (Asproth et al., 2006) in order to solve a practical operational problem. This approach will integrate research insights from both social and engineering (technological) sciences and result in an integrated crisis simulation and training environment – the netAgora tool – for multiactor coordination and decision support.

In trying both to take care of current research insights and meet the challenges in practicing rescue and security work we will develop the netAgora environment. Hence, within the project a computer and net based integrated environment for mutual preparation and training for disasters and complex emergency situations will be developed. The netAgora environment will be all comprehensive with a disaster simulator, a scenario editor, and an assessment kit included in its core. It will support cooperation, coordination, training, preparation, and learning on individual, group, and organisational levels. The netAgora will further include support for an exchange of experiences, tools, and models of response to emergence situations within and between the countries involved including the handling the cultural differences that may impede the emergence response.

Main components in netAgora are given as follows. The Virtual Situation Room (VSR) is the interaction surface toward the user. Through this surface (GUI) the user has access to all the other resources of netAgora. VSR may be freely adopted to meet the specific requirements of different user categories. There is no theoretical limit to the number of users that may simultaneously be connected to netAgora.

The Virtual Responder (VR) is a system component, which simulate the behaviour of other responders. From the point of view of the player there is no difference between a virtual actor and a real actor. This means that in netAgora there are always several actors, real or virtual ones, which you as user have to coordinate and communicate with.

The Disaster Simulator (DS) is the core of netAgora. DS can calculate (simulate) the dynamic evolution of a set of crucial disaster variables and react on different user decisions and actions. The ability to handle geographical or spatial information (GIS) is a crucial faculty of the Disaster simulator. The user can select a scenario, i.e. disaster, from the Scenario Bank (SB) or set up a new one, or change an existing one, with help of the Scenario Editor/Generator (SEG). The Assessment Kit (AK) helps the user to evaluate the decisions and actions taken during the playing of a scenario.

Experiences and Lessons Learned (ELL), at last, is a knowledge bank with tested and verified disaster and crisis knowledge. Via the Meeting and Cooperation Support (MSC) the user can interact and discuss with other disaster responders and via the Expert Panel (EP) she or he can put disaster related questions to a group of disaster experts and disaster researchers.

In short, the main objective of netAgora Environment is to provide, in one place, all the necessary resources and functions for best possible preparation, training, and learning in relation to crisis and complex emergency situations in a regional context.

GSS/netAgora, a cross-border project between Sweden and Norway will serve both as data source and test bed for verification of results.

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Emergence in the Disaster Response to the June 2007 Hull Floods

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Abstract: *There is a growing body of research that suggests much of the behaviour that occurs during a disaster response effort is emergent, meaning it is produced as a result of complex non-linear factors at work both within and between the affected communities, responding organisations, and the environment. This presentation uses the pluvial floods of June 2007 in Kingston upon Hull as a case study to investigate to what extent emergence was apparent during the disaster response effort, as well as identifying certain systemic features that facilitate or inhibit this emergence. Results show that emergent behaviours corresponding to each of the types identified in the literature (emergent groups, networks, and activities) were present in the response to the June 2007 floods; and that these behaviours contributed positively to Kingston upon Hull's community resilience. Both altruism and the relative rate of information transfer were key drivers for emergent actions.*

Keywords: complexity; disaster response; emergence; Kingston upon Hull; social impacts

1. Introduction

Over recent years there has been an increasing interest in non-structural or 'soft' engineering solutions to flood risk (and indeed hazard management in general). Of these non-structural methods, preparedness strategies are of particular interest, outlining the overall organisational strategy during times of hazard, the protocols that attempt to regulate the actions of the various actors involved, and the levels of authority they are imbued with. Smith and Ward (1998) observe that disaster management plans operate at times of unreliable information, acute time pressures and inadequate communication systems. It has therefore been suggested that planning should seek to enhance the adaptive capacity of the community and ideas emerging from complex system theory have been proposed as a means to produce such a strategy (Comfort 1999; Johnson 2006; Smith and Fischbacher 2009; Stallings and Quarantelli 1985; Tierney and Trainor 2003).

2. Disasters and Emergence

In disaster circumstances, the usual processes and structures of emergency response are often overwhelmed (Tierney and Trainor 2003) and consequently a linear, hierarchical response is generally the exception rather than the rule. The consequent assertion that some degree of non-linear, emergent behaviour is both inevitable and natural (Stallings and Quarantelli 1985) is supported by a number of case studies across a range of disaster scenarios and levels of development (Comfort 1999; Tierney and Trainor 2003). The purpose of this research was to determine to what extent emergent behaviours were evident in the response effort during the Kingston upon Hull, UK, floods of June 2007, when the Police instigated a Silver Control structure on the morning of 25th June. A central multi-agency Gold/Silver/Bronze Control is convened when any emergency situation is declared in the UK, in order to coordinate the response effort.

Flood preparedness is particularly relevant to the city of Kingston upon Hull, which has 90% of its area below the high tide level (Environment Agency 2008). June 2007 was the wettest month in Yorkshire since 1882. Nearly 10,000 properties were flooded during the pluvial floods of June 2007, causing extensive damage to the property of Kingston upon Hull's residents. Damage to Council property alone was estimated at nearly £200 million (Coulthard *et al.* 2007). During the floods, roads in affected areas became impassable for 2 days and 91 of Kingston upon Hull's 99 schools were forced to close. Official reports into the floods have covered issues of Hull's drainage infrastructure and flood defenses (Coulthard *et al.* 2007; OFWAT 2008; Yorkshire Water 2008), the financial and social impacts of the floods (Coulthard *et al.* 2007; Pitt 2008), the complexities of roles and responsibilities during flooding events (Coulthard *et al.* 2007; Environment Agency 2008), as well as the performance of the various agencies involved (Coulthard *et al.* 2007).

3. Methodology

In order to compile information from the numerous and diverse sources, a detailed case study was undertaken. Guidance on the necessary techniques and protocols needed for the production of this type of study were obtained from Yin (1994) and Hay (2002). Information for this case study was obtained from a number of sources, and where possible a process of triangulation between sources was used. Organisations of interest were identified in the aforementioned reports and accounts of the floods, and through communications with academics who are either conducting their own studies of the June 2007 floods, or have been heavily involved in published reports (Coulthard, 2008; Medd, 2008). While a number of groups were identified, time constraints meant that only those sited as being key could be included in this study, these were: Hull County Council, Silver Command, The Hull Community Wardens, The Environment Agency and flood-affected Residents. Yorkshire Water was approached to take part in this study, however after repeated requests no one was available for interview. Further contacts were made via the use of a 'snowball' sampling methodology. This harvesting of multiple perspectives from each organisation both reduces the probability that testimony is erroneous, and perhaps just as importantly, allowed comparison of the differing perspectives, methods of coordination, and types of behaviour present at different organisational levels.

Field data was collected over a period of days in August 2007. Interviews were structured using an interview outline based on obtaining a chronology of activities throughout the flood event, recorded, transcribed at a later date, and supplemented by further informal discussions which ranged over a wider set flood related topics. In total 7 (40-90 minute) formal interviews were conducted. Shadowing of council officials also took place during this time, as did discussions (15 – 25 minutes) with 4 residents affected by flooding. The data was analysed and discussed within the framework of emergence within groups, networks and activities. Emergent groups are made up of individuals who have informally banded together in order to pursue some common goal or necessary function. An emergent network is an organisational form distinct from others such as bureaucracies, markets and hierarchies (Tierney and Trainor 2003). Rather than formal procedures such as contracts or policies, exchanges within a network are regulated by trust and reciprocity (Podolny and Page 1998). Emergent Activities are activities which actors engage in that are novel or unusual for them in some way, particularly when these activities differ from those laid out in disaster plans (Tierney and Trainor 2003). Emergent behaviours discussed above have been cited as a major source of resilience within disaster networks (Comfort 1999; Tierney and Trainor 2003).

4. Findings and Summary

Overall the emergent behaviours were largely constructive. This was especially noticeable in the provision of timely assistance to Kingston upon Hull's most vulnerable residents. A common thread through all emergent behaviours identified was altruism, which was most often expressed in a desire to help or sense of 'courtesy'. There was however some evidence where certain unplanned activities were not constructive, even though these were universally undertaken with a strong desire to help. It was also apparent that emergent behaviours persisted throughout all phases of the response and recovery, though they progressively became part of a more coordinated response as time went on. It was also observed that emergence was often driven by the availability or rate of transfer of information between organisational levels. If information pertaining to action was not immediately forthcoming in a situation that appears to demand an urgent response, people began acting, with their behaviour governed by local exchanges through which information can be transferred much more rapidly. In the wider context of disaster management the results of this study imply that a better understanding of the contextual factors that give rise to emergence, together with knowledge of how emergent behaviours interact with more traditional organisational forms, is of great importance to ensure the resilience in the face of uncertain future hazards.

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Symposium D. Cybernetics of Country Development

Chairs: Paul Ballonoff, Ballonoff Consulting, Alexandria (VA), USA, and Tatiana Medvedeva, Siberian State University of Transport, Novosibirsk, Russia, and Stuart Umpleby, The George Washington University, Washington DC, USA

The Cybernetics of Country Development sessions are a long standing part of the EMCSR. Cybernetics from its inception has sought to treat problems of public policy, often implying actions of countries. At the period of transition from the Soviet system, EMCSR hosted several sessions that focused especially on mechanisms of the transition. Cybernetics itself has not shied from analysis that implies predictions, which in turn imply policy. If cybernetics and systems analysis is to be more than just descriptive analysis, but a serious foundation for policy … for prescription of action that is taken seriously and relied upon … then it must also be able to ask if the predictions are correct, and, as for any science, be able to change its methods when better forecasts are required. The EMCSR session on Country Systems has the dual objectives of accurately describing country development, and also, finding, if it is possible to find, a foundation for a reliable science of forecasting paths of, and thus successfully aiding, country development.

Tatiana Alekseevna Medvedeva: *Applying a Method of Extended System Analysis to Country Development*

Natalia Igorevna Guseva: *Cross-Cultural Synergy as Management Innovation for Increasing Multinational Companies' Competitiveness*

Stuart Umpleby: *Graduate Programs for Developing Countries*

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Applying a Method of Extended System Analysis to Country Development

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Abstract: *Computerization, new technologies, and globalization have changed dramatically social and economic conditions. The complexity of the problems faced by scientists in the 21st century makes it necessary to rethink many current social theories and research approaches so that they would be able to support full development of the networked, knowledge based economy and society. The systemic character of the problems requires fundamental changes in our thinking, but the various social science disciplines have adopted different methods for describing systems. Some disciplines describe systems as sets of interrelated variables (e.g., physics, economics). Some disciplines describe the behavior of a system in terms of a sequence of events (e.g., history, computer science). Some disciplines look at systems as collections of groups (e.g., political science, sociology). Some disciplines focus on ideas that influence behavior (e.g., psychology, cultural anthropology). When dealing with a complex social and economic system, all of these methods can be used to create a more holistic understanding of a social and economic system.*

There are many intellectual attempts to revamp current theorizing and to improve understanding among social scientists. One of those, which provides a fundamentally new, complex vision of society through the prism of a new understanding of life, is Fritjof Capra's approach, integrating the biological, cognitive and social dimensions on the basis of a theory of complexity.

This paper compares Capra's integrated conception for understanding social systems and four methods for describing systems. The paper also applies this multi-perspective approach to analyzing the changes in social and labor relations in Russia during the last 20 years of reforming the Russian economy.

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Tatiana Medvedeva is an Associate Professor in the Department of World Economy and Law at Siberian State University of Transport, Novosibirsk, Russia. At her university she is a former Director of the Scientific and Practical Center for Business and Management. She has also worked as Vice-director of the Institute for Prospective Transport Technologies. She has experience in educating and consulting with managers of Russian enterprises for work in the new social and economic conditions. During the academic year 2010-2011 she was a Visiting Professor in the Department of Sociology at Georgetown University, Washington, DC. In 1996 she was a Visiting Professor in the Department of Management, the School of Business at The George Washington University in Washington, DC.

She received a diploma in economic cybernetics from Novosibirsk State University and a kandidatskaya degree (Ph.D) in economics from Moscow State University. Most of her scientific interests and writings in Russia and abroad concern the economics of transitions and change management, particularly the changes in values, beliefs, and institutions now occurring in the post-communist countries; interactive planning methods; cross-cultural studies; total quality management; and a constructivist approach to educating managers.

Her research is quite interdisciplinary. She has published articles in *Systemic Practice and Action Research, Cybernetics and Systems, World Futures, Kybernetes, Reflexive Control,* and *Logistics and Sustainable Transport*. She has presented papers at scientific conferences in Russia, Austria, Greece, the Netherlands, USA, Sweden, Slovenia, Serbia, Poland, Hungary, and Romania.

Her biography can be found in the Marquis Edition of *Who's Who in the World, 2009.*

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Cross-Cultural Synergy as Management Innovation for Increasing Multinational Companies' Competitiveness

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Abstract: *This paper examines the hypothesis that synergy of cross-cultural differences is the key factor of increasing multinational companies' competitiveness in the process of globalization. We also consider synergy of cross-cultural differences as a management innovation applied to multinationals working in Russia. The author proposes new approach how to deal with cross-cultural differences and how to take advantage from multicultural diversity that is objective reality nowadays.*

The development of international cooperation, caused by the influence of globalization, leads to an increasing number of multicultural organizations. From the beginning of 1990's Russia has become a big potential market for Western companies. Many multinational companies apply their "managerial formulas" in Russia that are derived from and being successful in their own culture. But some questions arise about managerial practice that could be applied in Russia and in same time be considered as innovative and competitive.

Beginning with concepts of cross-cultural differences the paper presents a multimethod analysis of culture differences, which influence managerial theory and practice. Methodological research done by G. Hofstede (1991, 1995, 2001) H. Triandis (1995, 1996), E. Hall (1992, 1998), R. House (1999, 2004), F. Trompenaars and Ch. Hampden –Turner (1994, 2004), S. Schneider and J.-L. Barsoux (2003), P. d'Iribarne (1998) and others has formed the basis of theoretical and methodological principles of conducting cross-cultural research (Guseva, 2004).

The results of a comparative analysis of French and Russian national cultures, based on different systems of values and personality concepts enabled us to identify three groups of French - Russian cultural differences. The main interest and research focus was done to the first group presented by the most important cross-cultural differences: universalism – particularism; individualism – collectivism; endogene – exogene motivation; attitudes towards time. These are four fundamental dimensions of culture determine the way "how French and Russians solves problems" (Guseva, 2000, 2011).

Further in the paper we study the influence of cross – cultural differences on the main management processes such as multicultural team building, leadership, conflicts resolving and decision making, negotiating and motivating members of a multicultural team and their influence on multinational companies' competiveness (Chevrier, 2003; Caligiuri, Tarique, 2012; Gesteland, 2002; Muzychenko, 2008; Moran, 2001, etc.). We have explored these ideas using survey data on 51 foreign - owned companies operating in Russia and then present case studies designed to ground the results in the Russian context. The results of the study, based on a combination of quantitative and qualitative methods, enabled us to determine "Russian" and "French" efficient way of management, distinguish cross-cultural differences in core management processes and propose the mechanism of their harmonization.

The paper provides new approach of achieving cross-cultural synergy for increasing multinational companies' competitiveness based on such core values as mutual understanding, tolerance, empathy, respect and knowledge of basic values, traditions and peculiarities of a different culture. The results of empirical studies conducted by the author showed that 97.3% of the French and 88.9% of Russians have strong desire to continue the Franco-Russian cooperation, so that consensus in cross-cultural differences is an objective necessity.

In all the four major cultural dichotomies we have identified between Russian and French, there are two extremes can be found, but we propose to use the methodological approach, looking for synergy moving from extreme positions. Each pair of cultural settings - it is their mirror image, no way to say which way of solving problems or managerial practice is better (Adamopoulos, 1999; Harrison, Huntington, 2000; Hampden – Turner, Trompenaars, 2004; etc.). For example,

particularism is a mirror image of universalism, individualism – a mirror image of collectivism, and vice versa. However, between each pair of parameters that characterize the national culture, there is a sort of vicious circle. It is therefore necessary to find a compromise, a kind of "middle ground", other words - the consensus of cross-cultural differences.

The author presents her own vision and managerial recommendations how to reach the synergy in four main French – Russians dichotomies: individualism – collectivism; universalism – particularism; endogene – exogene motivation and attitudes towards time. We believe that competitiveness of French multinational companies relies more on their adaptability and flexibility to the Russian market.

Finally, the harmonization and synergy of cross-cultural differences is considered as the management innovation and the most important factor for increasing Western companies' competitiveness in Russia.

Keywords: cross-cultural differences; cross-cultural synergy; management innovation; effectiveness, France, Russia

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Graduate Programs for Developing Countries

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Abstract: *Currently universities are growing in numbers and resources in many countries. Universities are seen as a source of skilled labor needed to manage the development process and to operate modern institutions. Universities in developing countries usually seek to emulate the structure and degree programs of developed countries. However, some countries, such as Kazakhstan, are designing new kinds of degree programs. For example, in developed countries PhD programs require students to make a contribution to knowledge. In Kazakhstan the requirement for PhD students is to become familiar with the existing literature and then to make policy recommendations for the development of Kazakhstan. One topic might be, design a strategy for the improvement of human capital in Kazakhstan. Another topic might be, design a strategy for the improvement of petroleum refining in Kazakhstan. (The country currently exports crude oil and imports gasoline.) A more general topic might be, design a strategy for materials processing in Kazakhstan. That is, do not export raw materials. Instead extend the supply chain by exporting processed goods. As an example, do not export timber, instead export furniture, thereby creating more jobs in Kazakhstan.*

These kinds of dissertation topics are clearly important for a developing country. But they would not be considered dissertation topics at Western universities. They could be considered dissertation topics, if a producer-product conception of knowledge were used rather than a cause and effect conception of knowledge. Universities in developing countries may be more receptive to holistic thinking and systems approaches than universities in developed countries. This paper will describe several ways that a systems approach to knowledge creation can enhance the rate of development in developing countries.

Keywords: systems approach; knowledge creation; developing countries; PhD programs

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Symposium E. Cybernetics of …: Reciprocity and Reflexivity in Cybernetic Thinking

Chairs: Ranulph Glanville, Portsmouth, UK, Karl H. Müller, WISDOM, Vienna, Austria

Cybernetics has its origin in the inter-, trans- and meta-disciplinary. It provided, Margaret Mead claimed (1968), a means to allow us to create and share common understandings by developing a common language.

Thus, Cybernetics has always been an abstraction (remember Ashby's "cybernetics is the study of all possible abstract machines"), and has (like systems theory and other meta-disciplines) always been applied in other fields. But, like systems theory, for instance, it is a field in its own right, and again like systems theory, it can be applied to itself, as Mead also requested in the same paper: in analogy to systems theory, we have the cybernetics of cybernetics, or meta-cybernetics—also known as second order cybernetics, the cybernetics of observing systems (Foerster et al., 1974). More recently, some call this neo-cybernetics.

This symposium will focus on what the current approaches of second-order cybernetics bring to various fields, including second-order cybernetics itself. In keeping with the circular/spiral nature of cybernetic systems, it will, reflexively, ask the same question in reciprocation: what have the various fields brought to second-order cybernetics?

The symposium will consist of two elements: formal presentations on what we can learn from the bringing together of cybernetic insights in cybernetics and other fields: and round table discussions open to all who have attended the formal presentations, kick-started by panels of distinguished practitioners.

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Neosentience and the Abstraction of Abstraction

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Abstract: *This paper will use a survey methodology to point at notions surrounding "the reflexive" and "reciprocity" drawn from the history of Cybernetics as they fall in relation to current "Neosentient" research. Seaman and O. E. Rössler have been involved in a decade long discussion exploring the future of artificial intelligence and its relation to robotics. Seaman coined the term Neosentience arising out of an ongoing "conversation" with Rössler which is articulated in their book – Neosentience | The Benevolence Engine (Seaman & Rössler, 2011). The book is a non-linear compendium of observations, many of which are drawn from the history of Cybernetics and in particular explore "Reciprocity and Reflexivity in Cybernetic Thinking."*

We consider a Neosentient robotic entity to be a system that could exhibit well-defined functionalities: It learns; it intelligently navigates; it interacts via natural language; it generates simulations of behavior (it "thinks" about potential behaviors) before acting in physical space; it is creative in some manner; it comes to have a deep situated knowledge of context through multimodal sensing; and it exhibits a sense of play; it will be mirror competent and will in this sense show self-awareness; It will be competent to go through the personogenetic bifurcation (thereby acquiring the ability to articulate meta-levels and meta-patterns). We have entitled this robotic entity The Benevolence Engine. The interfunctionality is complex enough to operationally mimic human sentience. Benevolence can in principle arise in the interaction of two such systems. Each of these "pragmatic" benchmarks (as distinct from the Turing Test) (Turing, 1950; Stanford Encyclopaedia of Philosophy) will be discussed in relation to earlier cybernetic research.

Such questions as how do we Abstract Abstraction; how can such a system employ informed "reciprocity" – mutual exchanges and relational intra-actions as a central aspect of our and its "coming to be". In particular one central question is how can we embody the reciprocal nature of human benevolence in the Neosentient — How can the system be optimized such that "A is better off if B is better off" in the words of von Foerster? (Foerester, 1981)

For Neosentience research the goal is to understand the human to the greatest extent possible. This is self-reflection on the highest level, being undertaken as a continuous process --- an ongoing "chipping away" at the hardest of questions from multiple disciplinary perspectives that are being brought into dynamic relation. Seaman is currently working on the development of an "Insight Engine" in the service of this endeavor. The object is to employ biomimetics and bio-abstraction. Thus the project of Neosentience is highly paradoxical – one must continue to come to know the human at the highest level to begin to abstract human functionality into a machine. The human is already a computer, an ultra-abstract machine. Cognition, as von Foerster states = computations of computations. (Foerster, 1981) The study of Neosentience explores such issues as Science ↔ Art relationalities (Perriquet & Seaman, 2011), important to both Pask and von Foerster (Pickering, 2010; Glanville, 2011; Foerster, 1974). How do we become meta-observers? How do we abstract meta-operations across differing research domains? In particular how can we become meta-creative, exploring the creation of creativity algorithmically (or post-algorimithically)? How do we best reverse engineer our creative natures?

Additionally, the defining of a dynamic relationality across many research fields is a highly important concept to both Cybernetics and Neosentient study. The paper will point toward a series of disparate yet relevant ideas in a somewhat non-linear, non-hierarchical fashion, and discuss how they inform the project of "Neosentience". In particular, cybernetic notions surrounding abstraction and meta-level understanding will be explored as they relate to the Neosentient design. (Foerster, 2003; Müller, 2005; Pask, 1958) One area of interest is linguistic framing and titling that enables complex ideas that are "reflexive" to become embodied and shared. Linguistic frames and jargon shift across research domains. How can we design new context-aware systems that enable relevant jargon translation and use in interdisciplinary and transdisciplinary research and in turn, Neosentient design. We are "Observing Systems" – a lovely bidirectional articulation by von Foerster. A number of foci of relevance here were first articulated by von Foerster in Observing Systems (Foerster, 1981). We note the playful embodiment of reflexivity and polysemy in this title and other titles of von Foerster.

Seaman and Gaugusch in a paper entitled in (Re)Sensing the Observer call for an "Open Order Cybernetics" (Gaugusch & Seaman, 2004), seeing the open field of growth that language and technology suggest for the human. Open Order Cybernetics, continues to grow infinitely as it re-defines itself both linguistically (self-definition) and technologically [remembering language is also a technology]. This form of ongoing technological growth, as it alters the functioning of the

human exhibits a form of abstracted and/or augmented-autopoeisis (Maturana & Varela, 1980). This "open order cybernetics" also expands as a new form of observer comes into the picture– Neosentient entities. We must also point to cyborgian technological potentials as well as new potentials for computational linguistic "creativity" and "bisociation" (A. Koestler), (Koestler, 1964) informing our "open order" approach. Glanville in conversation with Seaman suggested that Second Order Cybernetics already exhibits such an open order perspective, which may well be the case.

Thus, a multi-perspective approach to knowledge production in the service of Neosentient Design is currently undertaken, "'Design' as every linguistic functionality" [Glanville] is explored (Glanville, 2007). Additionally multiple foci from Understanding Understanding (Foerster, 2003), a central von Foersterism becomes enfolded in our research into Neosentient Design and the abstraction of abstraction. The notion of patterns and pattern recognition here is central. A compendium of pattern and meta-pattern relations will also be discussed.

The goal is to form a reciprocal intellectual relation with the Neosentient. This is where benevolence comes in – optimizing toward the other. Thus the reciprocal relation of benevolent behavior always seeks to flow bidirectionally. Here the creation of a creative machine, exploring a meta-field of meta-fields becomes the greatest of transcontextual (Bateson, 1972) endeavors.

Cybernetics is the transcontextual science and art of pointing both inwardly and outwardly — relationally. Here, in the service of Neosentient Design, one seeks to abstract abstraction and articulate a topology of relationalities or better a relationality of relationalities in the service of insight production, technological creativity and ongoing self-reflection.

Keywords: neosentience; bisociation; neosentient design; artificial Intelligence; robotics; multi-perspective approach; 2nd order Cybernetics; insight engine

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About the Author

Bill Seaman

Bill Seaman, an internationally known media artist, scholar, and media researcher, has had over thirty major installation works and commissions around the world, a dozen solo exhibitions, and numerous performance collaborations, video screenings, and articles/essays/reviews in books and catalogues. His work often explores an expanded media-oriented poetics through various technological means. More recently he has been exploring notions surrounding "Recombinant Informatics" — a multi-perspective approach to inventive knowledge production. He has been commissioned on a number of occasions. He is currently working on a series of art/science collaborations — poetic installations and scientific research papers. The book *Neosentience* | *The Benevolence Engine* with Otto Rössler has recently come out through Intellect Press. He is also collaborating with artist/computer scientist Daniel Howe on multiple works exploring AI and creative writing/multi-media and completing an album of experimental music with Howe entitled Minor Distance. He is developing a new VR work and undertaking interface research with Todd Berreth; is exploring the creation of a transdisciplinary research tool — *The Insight Engine*; is collaborating with John Supko on a new generative audio work; and is working with Gideon May and Rachel Brady on re-articulating *The World Generator / The Engine of Desire* a virtual world building system.

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Experimenting Machines

Developing ideas for a research installation

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Abstract: *In this paper I examine a series of related pieces of research which consider the relationship between perception, emotion and external stimuli. Broadly, my question as a designer is, if we each find unique experiences in our world, why do we usually design the world around us with the assumption of a common experience? In designing interactive evolutionary systems, there is the possibility to create situations which adapt themselves in response to human interaction. The eventual behaviour of such a system is a product of experimentation by both the human and non-human components of the system. The paper discusses three related proposals for a new research installation and the associated ideas each raises.*

Keywords: perception; cybernetics; affordance; experimentation; emotion; body-affect-cognition

Acknowledgement: Professor Stephen Gage, Jason Bruges.

There is a common assumption that we all experience and inhabit the same environment. This normalising of perception serves many purposes. In everyday life it allows us to navigate and socialise, refer to and share our environment with others. Researchers interested in perception have for a long time suspected this is not the case. We each form a unique construction of our environment. Broadly, my question as a designer is, if we each find unique experiences in our world, why do we usually design the world around us with the assumption of a common experience? In my research I have been exploring aspects of this question through a series of physical test pieces.

Research into design, as an entity in its own right, began with a positivist approach arising out of the credibility of an established scientific epistemology. In traditional science human perception was rejected in favour of non-human quantitive measurements. If human perception cannot be quantified then it had no place in proper scientific practice, the conventions of positivist epistemology.

For design however, emotions such as delight and disgust with other subjective responses, are as important as functionality and quantitive performance. Indeed there is a growing body of research which suggests that emotional response directly affects the functionality and performance that people find in objects around them.

"The latest scientific findings indicate that emotions play an essential role in rational decision making, perception, learning and a variety of other cognitive functions. Emotions are not limited to art, entertainment and social interaction; they influence the very mechanisms of rational thinking." (Picard, 1997, p. 'x')

Building on research by Isen (1993), Norman (2004) suggests that objects which induce a positive emotional response in us perform better when we interact with them. The suggestion is that objects and responses which induce a positive mental state in a user, prime the user to more easily see solutions to inadequacies of these objects. The cognition, which results from the physical attributes of the object and the users perception of it, facilitates the object to perform better.

Studies by Bargh et al. (1996), suggest that our social and physical behaviour can be influenced by stimuli we find around us.

"Social behavioral responses are represented mentally just as are trait concepts and attitudes. Thus, they should be capable of becoming activated automatically on the mere presence of relevant features in the environment by the same principles that produce automatic trait categorization and automatic attitude activation." (Bargh et al. 1996, p. 231)

One study they performed found that participants who were primed with references to the elderly walked almost twice as slowly, to the exit after, than those who had not. One interesting aspect of this study was that different peoples' behaviour was modified in a similar manner by the same priming technique.

When the Millennium Bridge in London opened it famously wobbled. Initially small movements in the bridge induced movements in response from the people walking over it. This became feedback which escalated the 'wobble', the movements became exaggerated and the people on the bridge began to walk in step. A small trigger caused a large group behaviour.

Last year (2011) I exhibited a piece of work called 'I Have these Two Faces'[1]. There were two key ideas being explored in this work. The first was related to how the observers were categorised. Although this categorisation was crude, the installation evolved to treat people it categorised differently in a different manner, informed by other people of similar characteristics it had previously interacted with.

The second key idea was that the installation did not 'know' what its own output meant to an observer. The states of the output were initially random and would remain random unless a state induced an inferable change of emotion in an observer, in this case a smile. From this, the behaviour of the installation developed through a genetic algorithm. This was a circular human – nonhuman exchange.

In this system it could be considered that both the human and non-human are experimenting with each other. Both human and non-human make inferences of each other and attribute meanings to these, in turn they develop their understanding and behaviour accordingly.

The human in the system is perhaps seeking to understand the machine, to learn a control (Pask, 1971). The non-human is experimenting with its self. The latter has an objective (to increase the number of smiles it induces/detects) but it does not 'know' how to achieve this. It does not understand its own output, the algorithm controlling its output is a conceptual device and it bears no relation to the device's physicality. However over time the non-human system becomes more successful, through observing human response to it.

I am aware that in the description above I have attributed human characteristics to the control software. I believe this may be a productive conceptual approach in designing systems of this nature.

"There are circularities in setting up and doing the experiment, in valuing what is found and integrating it. There are circularities of repetition. The whole process is deeply embedded in circularity, particularly the greatest of all scientific circularities: the active involvement of the experimenter (the observer)." (Glanville, 1998)

In this paper I propose to discuss my approach to my next research installation. I envisage this to be a public social space, with a range of nonfigurative outputs. These will primarily be visual, through the use of lighting and animate physical devices to operate in relation to the lighting. The

[1] I have written a more detailed analysis of this work in the past (Di Duca, 2011), a video of the project can be seen at http://www.diduca.co.uk/#1719094/I-Have-these-Two-Faces

installation will use computer vision to infer characteristics of the behaviour of observers within the space. These observations will primarily concern the gross body movement of the observers. The installation will evolve its output behaviour over time in response to observations and interaction with people in or around the space.

There are three approaches I am considering to explore, each of which could lead to interesting social behaviour;

1. The first is to give the space an agenda, to seek a pattern of behaviour in people who are in or pass through the space.

2. The second is for the installation to have two spaces, one for observers 'in' the installation and one for observers 'of' the installation. The installation may try to manipulate the behaviour of the observers 'in' in order to 'see' a certain reaction from the observers 'of' who are watching the first group.

3. The third is to have a series of spaces, each of which would have the same hardware and range of output states, and initially the same software. However each would have a different agenda. For example one space might be seeking to make people smile and another might be seeking to make people frown.

In each of these three scenarios the installation would begin with an output behaviour, perhaps generated at random, and over time this behaviour would develop through interacting with observers. The eventual behaviour each would develop would be a product of interaction with observers and from experimenting with its own output.

I will present a detailed description of the above options for discussion at the conference, thereby initiating a conversation about three (hypothetical) conversations between observers and their environment.

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Collaborative Systems Design for Innovation and Creativity

From Social Netwoks to Collective Intelligence

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Abstract: *Author's purpose is formulation of major principles that could help to design, improve and use software for creative collaboration of work teams, communities and users of the global social computer networks. Methodology is inspired by ideas of the Computer Supported Cooperative working and based on comparative analysis of free collaborative systems (CS) that intended to be used for generating new ideas and innovative solutions: "Opinion Space" (UC Berkeley, USA), "Thinking Club" (Thinking Club Inc., Russia) and "Invention Machine Goldfire" (Invention Corp., USA). Author makes differentiation between levels of collaboration: social network, collective mind, and collective intelligence. This framework helps to identify potential of existing collaborative systems and design criteria for "ideal" creative CS. Author describes "ideal" creative CS's elements and functions.*

Keywords: collaborative systems; computer supported cooperative working; creative collaboration; collective intelligence; social networks

Acknowledgement: I would like to thank Oleg Manchuliantsev – entrepreneur and creative leader - who took creative insights from my training into the "Thinking Club" project, and Ken Goldberg – professor from UC Berkeley and media artist - who got me involved in very fruitful discussions about creative potential of the Opinion Space.

The Internet and Social Media technologies provide unique opportunities for on-line collaboration between corporate workers, community members, expert groups etc. The use of collaborative systems (CS) is important element of knowledge management in corporate world and public participation in social realm. There are multiple issues that CS designers have to face: How multiple points of view can be presented and structured? How can we structure and organize existing and emerging knowledge? How do we keep collaborative process issue/task oriented? How can we incorporate facilitation and creative thinking methods into collaborative process? In this paper we address the issue of creative collaboration and all the questions just mentioned we will discuss from this perspective. How can we effectively use "collective mind" to come up with something new and creative? What are the founding principals for collaborative systems design to make them a platform for finding new ideas, solutions, decisions etc.? Our purpose is to formulate these major principles for creative CS designers and users. To achieve the purpose we apply comparative methodology based on critical analysis of existing collaborative systems: "Opinion Space" (designed at UC Berkeley, USA), "Thinking Club" (designed by Thinking Club Inc., Russia) and "Invention Machine Goldfire" (designed by Invention Corp., USA). These particular cases are taken because their aim is creative collaboration for finding new ideas and solutions using "collective mind". Presented research is inspired by Open Innovation movement (Chesbrough H., 2005; Chesbrough et al. 2008) and practical guides for virtual creative teams (see Katerine (kit) Brown M. et al. 2007; Silber L. et al. 2009). Our contribution is a new conceptual framework presented in this paper: collaborative systems are discussed from the perspective of their development from network interaction to collective intelligence collaboration.

1. Collective mind and collective intelligence: creativity drivers for collaborative systems

For better understanding of collaborative systems we should make difference between social networks, collective mind and collective intelligence. Computer based social networks (SN) are platforms for one-to-many and many-to-many communication and interaction. SN must be simple, fun and user-constructible so social interaction becomes easy and multimedia. When SN is used to mobilize knowledge and expertise for specific task, it "evolves" into collective mind (CM). At this level collaboration around knowledge content and its processing becomes more important than fun and simplicity. If we organize CM with specific methods, techniques and instruments (say, thinking tools), it further "evolves" into collective intelligence (CI) (this popular concept is widely discussed see (Zara, 2004). CM is about methodology and organized process that gives much better quality and structure to CM. We consider this differentiation as important conceptual framework for analyzing collaborative systems design.

1.1. "Opinion Space" – designing visual expression for collective mind

"Opinion Space" is a new Social Media technology designed to help communities generate and exchange ideas about important issues and polices" – this is a statement from official Opinion Space web-site (see http://opinion.berkeley.edu/landing/). This CS designed by Ken Goldberg's group at UC Berkeley Centre for New Media. The key feature of the system – visual map that represents different opinions expressed through agreement/disagreement reactions to five different statements related to particular issue. To start working with "Opinion Space" user should register, choose the issue from the system's current agenda and (dis)agree to five statements (using graphic sliders). After that user's opinion appears in a map as separate point, surrounded by other user's points. Users can get to know each other's positions and suggested ideas by clicking on the point. They also can evaluate and rank ideas and suggestions (this where most of the collaboration happens as filtering). Collaborative power of the system is measured by community engagement, diversity of viewpoints expressed and their consideration (including the scale of distribution), solicitation inputs from community members, insights and ideas expressed and evaluated. Collaboration can be provided both for particular organization (corporation) and small or large-scale communities ("Opinion Space 3.0" was launched for US Department of State). Following our differentiations, "Opinion Space" goes into the category of "collective mind". The system aggregates collective knowledge and makes it structured as a visual map. It is also still rooted in the idea of easiness and fun that rule SN. There is no specific methods or techniques to facilitate thinking or creativity. But still the way system maps collective knowledge makes it convenient to use as a brainstorming tool for communities and corporations.

1.2. "Thinking Club" – creative collaboration for collective intelligence

"Thinking Club" collaboration system is web-based Open Innovation platform. It is "a social oriented software which aim is to bring new ideas for competitive business development and corporate problem solving" (*Thinking Club: First Open Innovation Platform in Russia, http://thinking-club.ru*). This CS implements the idea that corporate innovations are driven by external knowledge and knowledge outsourcing. "Thinking Club" (title is probably coined following Thinking Club movement set up by creative thinking guru Edward de Bono (De Bono E., 1992)) can be described as a creative on-line broker that takes together companies and "thinkers" for working on particular practical task. The task holder set up agenda in the form of short written proposal, indicating problem, goal, and expected outcomes. Members of the thinking community sign up for the task and creative process begins. The key feature of this system is use of thinking methods (taken from different methodologies, such as Lateral Thinking or Theory of Inventing Problem Solving – TRIZ). Thinkers go through the set of questions that are based on different creative thinking techniques. All ideas go to the idea bank with authors and names. After that all ideas are ranked by all users and task holders. Best ideas get rewards (monetary or symbolic) through collective filtering.

The system is purely generative, so it does not lock us in the room of personal judgment/opinion. However, there is no sophisticated visualization instrument. Because it is in-depth intellectual work designers gave up "fun and easy" interface elements. "Thinking club" runs individual "text in the box" interface. It works as a part of individual creative process but almost makes no sense in terms of common knowledge structuring. So here we deal with collective intelligence, which is based on creative thinking methods and techniques but lack collective mind's power to organize and share knowledge.

1.3. "Invention Machine Goldfire" – collective intelligence with virtual expert

"Invention Machine Goldfire" is the software solution that delivers this synergy by applying time-tested ideation methods integrated with patented knowledge-enabling semantics… the resulting synergy enables global workers with a sustainable capability for high-quality product and process innovation" (The Sustainable Innovator. White Paper, 2008, p.3). "Invention Machine Goldfire", designed by Invention Machine Corp.,, is a market success. It is collective intelligence solution for corporations, that promises to provide sustainable innovation process, but mostly for technical tasks and technological development. The Task Templates of the system allow users to communicate with Goldfire just asking "How" questions. Main interface is typical "text in the bow" with hyperlink indexing and interaction. Semantic Engine helps to search knowledge bases, index "tribal knowledge" of corporate documentation and formulate interdisciplinary answers. The key feature of the system is superficially structured knowledge in the form of knowledge bases (research publications, patents, corporate documentation), integrated with semantic indexing and ideation management (based on the Theory of Inventing Problem Solving – TRIZ (Altshuller G., 1984). So what we have here is very careful connection between well-structured knowledge (collective mind) and thinking methodology (collective intelligence). There is a significant distinction in the "Invention Machine Goldfire" design. It has built-in virtual expert function (VSME – Virtual Subject Matter Expert). This is autonomous intellectual function that provides problem analysis, knowledge navigation and creative solution generation. VSME collaborates with users helping to make expert function and knowledge utilization more effective. However, "Invention Machine Goldfire" is not design to be a highly engaging creative flow similar to Opinion Space. It is very much restricted to existing knowledge bases and makes open expression of ideas more or less marginal process. So there is no shared common knowledge space or map.

2. Conclusion

Following our comparative analysis of the free collaborative systems we can formulate major principals for creative CS design:

1.Creative collaboration can be launched on the different levels: social networks, collective mind and collective intelligence.

2.Bootom-up opinion and idea expression in the common and neutral visual space help to create open and emergent "crowd creativity".

3.Creative collaboration is knowledge based (collective mind) and requires knowledge structuring elements that help to balance in-depth expertise and wide participation.

4.Use of simple creative thinking techniques in the time structured sessions help to make creative collaboration productive and efficient (collective intelligence).

5.Productivity of creative CS depends on its ability to generate new ideas and solution that are practical and innovative

6.Collective mind and collective intelligence can be effectively integrated by virtual expert or intelligent functions of the system itself.

7.Ideal creative CS should have crucial elements and functions, including (social network platform, visual knowledge representation interface, structured dynamic knowledge base etc.)

There are limitations for direct application of our results for collaborative management systems since didn't consider management issues directly. There are also limitations of empirical data used since we analyzed only free systems and didn't discuss other collaborative systems. But still we pretend that our conceptual framework and major principles can be applied as a framework for critical analysis or existing collaborative systems (such as Mind Manager, MS Project or Imaginatik).

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Designing and Developing a Reflexive Learning System for Managing Systemic Change in a Climate-Change World Based on Cyber-systemic Understandings

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***Abstract:** We offer a reflection on our own praxis as designers and developers of a learning system that is studied by mature-age students through the Open University (OU) UK's internationally recognised supported-open learning approach. The learning system (or course or module), an investment of between £0.25-0.5 million to develop, thus reflects our own history (traditions of understanding), the history of the context and the history of cyber-systemic thought and praxis including our own engagement with particular cyber-systemic lineages. This module, 'Managing systemic change: inquiry, action and interaction' was first studied by around 100 students in 2010 as part of a new OU Masters Programme on Systems Thinking in Practice (STiP) and is now in its second presentation to over 100 students. Understanding and skills in systemic inquiry, action and interaction were intended learning outcomes. Through their engagement with the module and each other's perspectives students develop critical appreciation of systems practice and social learning systems, drawing on their own experiences of change. Students are practitioners from a wide range of domains and through activities such as online discussions and blogging they ground the ideas that were introduced in the module in their own circumstances and developed their own community. In this process they challenged themselves, each other and the authors as learning system designers. We reflect on what was learnt by who and how and for what purposes. Issues of learning system design and facilitation of learning are addressed. Assuming that our climate-changing world is unknowable in advance the need to take more responsibility for systemic effects of our actions through effective systems practice is discussed. Two conceptual strands incorporated into the design are highlighted and explored. Firstly Etienne Wenger's idea of a landscape of practices is used to map what learning for sustainability in times of accelerating change might look like. Secondly, systemic inquiry, an institutional innovation that is an antidote to living in a projectified world, was central to the design and shows promise as a means for organising praxis in contexts of uncertainty.*

Keywords: cyber-systemics; communities of practice; systemic inquiry; reflexivity; bringing forthness; design turn

1. Learning system design and facilitation of learning – some general principles

Following Wenger (1998) we contend that learning of itself cannot be designed but social infrastructure that fosters learning can be and that there are few more urgent tasks in today's societies. Ison et al. (2007) distinguish between first- and second-order design of learning systems by applying *cybernetic* frameworks of understanding. First-order design is characterised by blueprints, goal-seeking behaviour and an assumption that control is possible. Second-order design contextualises whatever is designed and occurs when designers show awareness that the design setting includes themselves and their history. Wenger's notion of design for learning is more in keeping with second-order logic.

Considering the world as a learning system using a communities of practice approach can help increase our societal capacity for inquiry and our ability to continuously create, adapt and develop change practices that are contextualised and thus more likely to be robust and viable over time (Blackmore, 2010). This particularly applies if those involved appreciate both the process and outcomes. The design of learning systems, as understood in our work, places importance on understanding the history of a situation and appreciating the traditions of understanding out of which those involved think and act (Ison & Russell 2007). This is equally true of the situation of designing the module we use here as a case study.

In keeping with a second-order design approach, where designers need to be aware of how the design setting includes themselves and their history, the authors/designers of TU812 began by considering their own histories and their own understandings of the system of interest of which TU812 was a part. The notion of a 'trajectory' was used – a past, present and future pathway – developed by Wenger (1998) to help people understand their identities in relation to a community of practice. The example of the authors' trajectories was also used to guide students to explore, and share with each other in their online forum, their own trajectories as points of entry to the module.[1]

As the module title suggests inquiry, action and interaction are three key elements of managing systemic change. Inquiry, referred to as 'systemic inquiry' in the module (following Churchman 1971 and Checkland – see Checkland & Poulter, 2006) is, we argue, a key form of practice for situations that are best understood as interdependent, complex, uncertain and possibly conflictual and in which there are multiple stakeholders each with their own history and perspective. Systemic inquiry, in the sense developed in this module, is also an expansion of traditional practices associated with project and programme management because it assumes uncertainty and complexity as a starting point. Systemic inquiry can be seen as an antidote to living in an increasingly 'projectified world' (Ison, 2010).

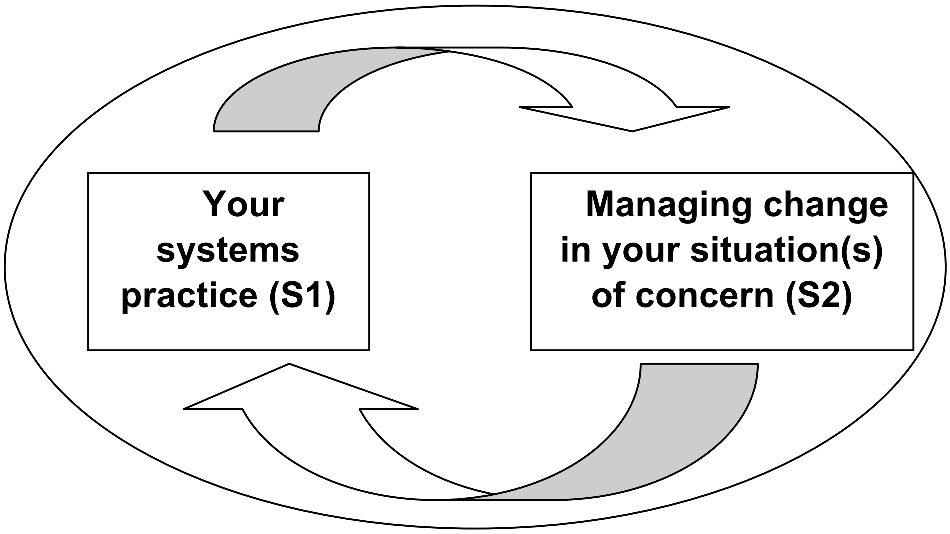

Figure 1. A virtuous cycle of inquiry in which an appreciation of systems practice (S1) when enacted can contribute to managing change in a situation or situations of concern (S2) that is systemic, at the same time as deepening understanding and practice of systems practice (S1) which can be applied in new situations (Sn).

The way 'action' is understood in the module is straightforward – it is about putting thinking into action to effect change, change that is systemically desirable and culturally feasible i.e., it is change that is more than being just desirable or feasible. As all action is achieved through some form of practice a key element of the module involves the learner critically exploring what systems

[1] A "student" in the Open University has the median age of 32 and is probably in full-time employment whilst studying – they may also come from anywhere in the world though a greater percentage come from the UK and then continental Western Europe.

practice is and how it can be done as well as appreciating what sort of difference it can make (this is S1 in Figure 1). In the module students undertake two systemic inquiries; as Figure 1 depicts the course is about reflexive practice, which is more than reflective practice i.e., we understand reflexivity to be a second-order practice involving reflection on reflection.

Of course no person is an island unto themselves so it is unlikely that effective change can be achieved without some forms of interaction, particularly with other ‘stakeholders’ in a situation. This might include work colleagues, people from other divisions or organisations, supply chain personnel, customers, clients, patients or citizens etc. Whilst the module design recognises this ‘truism’ the question of whether to start out in a group-based setting or to build up to concerns about group-based praxis became an issue of concern for the module designers and the person who took the role of external assessor, one of the OU’s quality control mechanisms. In the end the module design starts with the practitioner and their situation (Part 1), expands to include the dynamics of practitioner, situation, frameworks and methods (Part 2) and then expands to include material that develops skills and understanding and interaction through social learning and communities of practice (Part 3). This design recognises that as more stakeholders become involved the complexity expands as do the demands for practice involving interaction of some form with others (stakeholders, clients, employees, employers etc). Had our situation involved face-to-face teaching or more interactive blended learning we would probably have started out differently.

This module also deals with interaction in another way. As Checkland and Poulter (2006) note ‘systems ideas are fundamentally about the interactions between parts of a whole’. We describe these ‘wholes’ as systems of interest that are formulated by someone in purposeful ways so as to know about, and change, situations of interest/concern in systemically desirable ways. Sustainability from this perspective is humans engaged in purposeful behaviour to navigate a viable future in a co-evolutionary dynamic between themselves, other species and the bio-physical world. A normative position that underpins the module we explore as a case study is that currently our individual and collective skills and capacities to think and act systemically are underdeveloped, yet urgently needed in the face of human induced climate change and other interacting issues such as biodiversity loss, peak oil, over consumption and human wellbeing. Inquiries that explore and reach accommodations between different interests as to what is systemically desirable, when managed well, also have the potential to transform what is culturally feasible in context sensitive ways. This happens through reflexive learning, which, as our case study shows, is possible to design for and deliver.

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The Mutual Relevance of Cybernetics and Brazilian Culture

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Abstract: *This paper argues that concepts such as feedback, circularity, betweenness and conversation, in the way they are articulated by Cybernetics, have been historically present in Brazilian culture. It is proposed that a close investigation of Brazilian social characteristics under the light of Cybernetics principles could be of mutual interest, as it could shed new light on both sides. Brazilians could benefit from having a formalized tool to deal with an otherwise 'untamed trait' and cyberneticians could have a vantage point to investigate how an entire society, albeit rather unconsciously, has long lived within some of the Cybernetics principles.*

Keywords: Brazil; cybernetics; informality; syncretism; play; plasticity

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1. Cybernetics and Brazilian culture

Cybernetics has brought into western culture a new way of dealing with unstable systems by looking into the "control and communication in the animal and the machine" (Wiener, 1948), questioning the idea of a linear causality and contrasting it with the notion of feedback. With the development of second order Cybernetics the ability to approach unstable systems increased as the emphasis shifted towards circularity, interaction and betweenness, as Glanville (2004) puts it. Furthermore, with the acknowledgement of the observer as an essential part of any observed system, conversation became a central issue for Cybernetics. In short, Cybernetics has taught us that self-regulatory and unstable systems can be better understood with the help of concepts such as feedback, circularity, interaction, betweenness and conversation.

Curiously, these concepts, as they deal with fluctuation and plasticity of a system, bear a significant resemblance to typical aspects of Brazilian culture. Brazil, as any other country, is described through stereotypes that, although very simplistic in their rendition, undeniably bear some truth. The mixture of samba, carnival and football, that seems to be intrinsically linked to Brazilian image, does capture some real aspects of a nation that is laid back, playful and has a strong tendency to informality. Brazilians are notorious for having a casual approach to any rigid structure, be it a timetable, an organization hierarchy, or even a social convention. These features can be encapsulated in two almost topological concepts: *malleability* and *amalgamation*. Moreover, these two concepts seemed to be linked to the more general principles of plasticity and play.

The playful blend of *malleability* and *amalgamation* manifests in various social traits and activities that present a dynamic stability. By doing so, they end up displaying some similarities to a cybernetic system. Capoeira, that is at the same time a dance and a martial art developed by the African slaves, is a compelling example of that. In its origin it was a fitness training for the slaves, disguised as a form of dance in order to avoid the police repression. It is played in informal public gatherings by two opponents with a very loose and minimum set of rules, allowing space for creativity that develops into a kind of body dialogue based on flexibility and improvisation. As von Foester liked to compare Cybernetics to a dance (Waters, 1999), we can say capoeira may be seen as an accurate expression of second order Cybernetics conversation as it is a vivid concretion of a dialogue in action.

2. A country without a place

For certain that a great deal of social activities in any given culture or nation is similar to second order Cybernetic principles for the simple reason that those principles were thought of from a social point of view. However, the idea of syncretism, playfulness and informality has acquired an almost foundational myth status in Brazilian culture that makes it a special case. In some other countries these 'traits' are accepted as an exception, as in Brazil they are the norm and seem to prevail in all levels of daily activities. Historically speaking, they were the result of a melting pot comprised of native indians, black slaves and European Portuguese that respectively contributed with malleability, playfulness and amalgamation. Padre Vieira, a Portuguese missionary in colonial times, wrote about the 'inconstancy of the savage soul' (Castro, 2011), comparing the native indians to a myrtle sculpture - easy to impinge a shape on but hard to keep it permanent.

However, these features, despite being accepted as the basis for a creatively engaged population, are also considered a drawback especially when measured against the more sober European centred culture. In early 1900, the Brazilian sociologist Euclides da Cunha (2003) wrote that Brazil was doomed to civilization - it would either civilize itself or it would perish. To no surprise, the national flag carries the positivist motto 'order and progress', which, in a way, points out the internal struggle of a country trying to get rid of some of its innermost peculiarity, the mixture of modernity and primitive culture.

3. Conclusion

Due to historical reasons, Brazilians are accustomed to deal with unstable conditions, finding ways to come to terms with the situation by means of allowing for the existence of ill-defined structures, which are capable of accepting and accomodate errors. Concepts such as feedback, circularity, betweenness and conversation, in the way they are articulated by Cybernetics, have been somehow present in Brazilian culture for centuries. In fact, they characterise and distinguish Brazilian people in a world scenario. That is not to say that Cybernetics already existed in Brazil *avant-la-lettre*. On the contrary, the country has historically struggled with the problems that are better handled with the tools developed by Cybernetics. Actually, the problems tackled by Cybernetics seem to be more unmanageable for Brazilians because we have them not as a marginal issue but rather as a central aspect of our social fabric.

Thus, a close investigation of Brazilian social characteristics under the light of Cybernetics principles could be of mutual interest, as it could shed new light on both sides. Brazilians could benefit from having a formalized tool to deal with an otherwise 'untamed trait' and cyberneticians could have a vantage point to investigate how an entire society, albeit rather unconsciously, has long lived within some of the Cybernetics principles. In other words, if Cybernetics wants to be relevant for a world in crisis, as the call of this conference puts it, it is worthwhile looking at how Brazil has dealt with an almost permanent crisis by means of resorting to processes akin to feedback and circularity arranged within a relational and topological social structure.

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An Online Conversational Learning Environment Based on Quasi Entailment Mesh

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Abstract: *In this study, we will introduce an online learning/reflecting environment based on Gordon Pask's Entailment Meshes. We will discuss alternative ways of its implementation and elaborate on the opportunities and challenges of designing and developing different media that can activate different ways of "seeing-as" and reflection-in-action.*

Keywords: entailment meshes; reflection-in-action; interaction of authors; crowdsourcing

1. Introduction: Quasi Entailment Mesh and Reflection-in-Action

This paper proposes a specific virtual environment for conversational knowledge production which brings together knowledge from these two learning fields: Gordon Pask's "Conversational Theory" and Donald A. Schön's "Reflection in Action". It will discuss the benefits of the proposed online environment in which learning can take place through interpreted formal relationships in a certain context. Furthermore, it will elaborate on the opportunities and challenges of designing and developing different media that can activate different ways of "seeing-as" and reflection-in-action (in and beyond the design domains). In this context, a short review of former studies will be made (Section 2) and examples of interactive simplified (quasi) Entailment Mesh visualizations (which were based on data collected through various workshops) will be introduced (Section 3).In Section 4 alternative ways of implementing the proposed online environment will be discussed with illustrative interaction scenarios.

2. Review of the Previous Work

Classic examples such as Pask's (1975) CASTE (Course Assembly System and Tutorial Environment) and Pangaro's Thoughtsticker will be revealed in this section.

Donald A. Schön's description of "Reflection in Action" will be visited to establish links between the "Conversational Theory". Furthermore, Glanville and Pak's (2010) "Quasi Entailment Mesh" will be discussed.

3. Interactive Visualization of Quasi Entailment Meshes

In this section, the author's former studies on the interactive visualization of Quasi Entailment Meshes will be revealed. These interactive visualizations were created as a result of a real-life conversation on cybernetics between various participants. They are interesting because participants can "construct" various definitions of cybernetics and elements of their conversation on this topic in a relational manner and explore the explanations attached to these links.

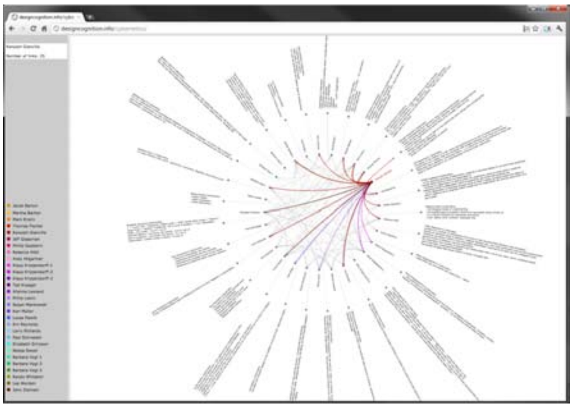

Figure 1. Interactive Visualizations of Quasi Entailment Meshes based on data collected through a real-life workshop. http://urbanarchitecturedesign.be/cybernetics/

4. A Web-based Visual Learning Environment for Social Knowledge Construction

In this section the conceptual design of a "learning/reflecting environment" will be introduced. It is a dynamic online space that aims at bringing together people and ideas from different practice domains where they can discuss ideas in forms of logical entailment(s)). The core of the proposed online environment is a web based application in which participants and “learnables” are represented as simple graphic entities. Using this application, participants can visually create a discussion subject which also creates an online interactive “conversation room”. In this virtual room, they can add topics related to the subject, define directional relations between topics and describe these relations. Parts or all of these elements can also be grouped, nested to create a more comprehensive knowledge construction. It is also possible to link these knowledge constructions with each other, which can lead to a larger and hopefully circular body of knowledge.

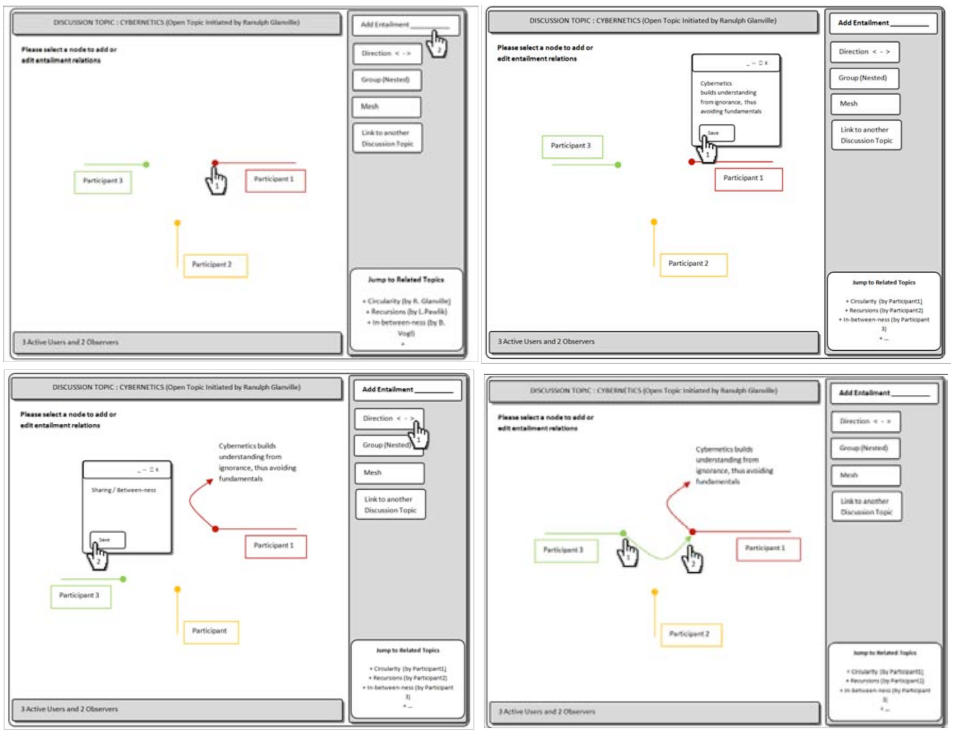

Figure 2: An interaction scenario for the reflective collaborative construction of a Quasi Entailment Mesh

5. Conclusions

In conclusion, the opportunities and challenges of the development and implementation of the proposed online conversational learning environment will be discussed. In addition, a set of key criteria for the future development of the environment will be introduced.

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Ranulph Glanville studied architecture, followed by 2 PhDs in Cybernetics, ad in Human Learning. In 2006 he was awarded a higher doctorate, DSc, in recognition of his contributions to design and cybernetics. Currently he is president of the American Society for Cybernetics. He is a professor at the Royal College of Art, London, Sint Lucas School of Architecture Brussels and Ghent, Hong Kong Polytechnic University and the Nuiversity of Newcastle, Australia. He is emeritus professor of architecture and cybernetics at University College London.

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Symposium F. Fourth International Symposium on Agent-Based Modeling and Simulation (ABModSim-4)

Chairs: Stefania Bandini, University of Milano-Bicocca, Milano, Italy, Paolo Petta, Austrian Research Institute for Artificial Intelligence, Vienna, Austria, and Giuseppe Vizzari, University of Milano-Bicocca, Milano, Italy

The notions of agents and multi-agent systems have been adopted for the modeling of complex systems in the most varied contexts: from social sciences to urban planning, biology, logistics and production, and many other more. Agent-based models and simulators are used for research as well as for business/industrial applications. However, the concepts behind the term 'agent' are often quite different, as well as the goals, phases and practices involved in modeling and simulation activities. This leads to different approaches, models, mechanisms, methodologies and developed computational systems supporting simulation of the modeled realities. The aim of this workshop, building on the experiences and results of the previous editions held in 2006, 2008 and 2010 is to bring together competencies related to agent-based modeling and simulation in different contexts, first of all to foster cross fertilization but also on one hand to understand what are the particular features of this kind of approach that made it so successful and widespread and to deeply explore the features that differentiate it from other computational approaches to the investigation of complex systems, like physical approaches and Cellular Automata. The theme for this year's edition of the symposium is thus "Untapping the true potential of Agent-Based Modeling": the authors are invited to go in the details of the features of the agent-based approach that made them opt for it instead of different alternatives.

Jun Zhang, Wolfram Klingsch, Tobias Rupprecht, Andreas Schadschneider & Armin Seyfried: *Empirical Study of Turning and Merging of Pedestrians Streams in T-junction*

Lorenza Manenti & Giuseppe Vizzari: *An Agent-Based Model for Pedestrian and Group Dynamics Applied in a Real-World Scenario*

Genivaldo Silva, Ronaldo da Silva, Jones Albuquerque, Silvana Bocanegra, Tiago Alessandro Ferreira, Jordi Ferrer-Savall, Daniel López-Codina, Marco Antônio de Souza, Reinaldo Souza-Santos & Constança Barbosa: *Modelling a Real Data Cellular Automaton to Analyze the Schistosomiasis Expansion Process Along the Coastline of Brazil*

Jordi Ferrer, Jones Albuquerque, Clara Prats, Daniel López & Joaquim Valls: *Agent-based Models in Malaria Elimination Strategy Design*

Steven L. Lytinen & Steven F. Railsback: *Agent-based Simulation Platforms: An Updated Review*

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Empirical Study of Turning and Merging of Pedestrians Streams in T-junction

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Abstract: *Agent-based models are becoming indispensable tools in building design, safety assessments as well as management of emergency egress. However, reliable calibrations of these models should be mandatory before they are used in practice. To improve the database for model calibration we present results from two experiments at a T-junction and a corner. In such structures the dynamic of pedestrian streams are complex and up to now not studied systematically. To understand it deeply, series of well-controlled laboratory experiments are conducted. The Voronoi method, which is used to analyze the experiments, allows high resolution and small fluctuation in time and space. From the results, it is found that the fundamental diagrams of pedestrian flow in T-junction are not the same before and after merging. At the same density, the velocities of pedestrians before merging are smaller than that after merging. To analyze whether turning or merging of the stream is responsible for this discrepancy, we compare the fundamental diagrams of pedestrian flow in T-junction with the flow at a single corner. The fundamental diagrams of the streams before and after corner agree well and are also in accordance with that from T-junction flow after merging. Besides, space-resolved measurements for the density, velocity profiles are obtained using Voronoi method. These maps offer important information about dangerous spots and thus enable to improve egress management and facility design.*

Keywords: Fundamental diagram; Voronoi diagram; T-junction; pedestrian experiments

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Jun Zhang is Ph.D. student of civil engineering at the Bergische Universität Wuppertal in Germany. He studied in safety technology and engineering got master's degree at the University of Science and Technology of China in 2009. His research topic is pedestrian dynamics, focusing on egress modeling and empirical data analysis to describe the pedestrian movement.

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An Agent-Based Model for Pedestrian and Group Dynamics Applied in a Real-World Scenario

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Abstract: *The simulation of pedestrian dynamics is a consolidated area of application for agent-based models: successful case studies can be found in the literature and off-the-shelf simulators are commonly employed by decision makers and consultancy companies. These models, however, generally do not consider the explicit representation of pedestrians aggregations (groups), the related occurring relationships and their dynamics. This work is aimed at discussing the relevance and significance of this research effort with respect to the need of empirical data about the implication of the presence of groups of pedestrians in different situations (e.g. changing density, spatial configurations of the environment). The paper describes an agent-based model encapsulating in the pedestrian's behavioural specification effects representing both traditional individual motivations (i.e. tendency to stay away from other pedestrians while moving towards the goal) and a simplified account of influences related to the presence of groups in the crowd. The model, tested and calibrated in in a simple scenario, has been applied in a real world scenario characterized by the presence of organized groups as an instrument for crowd management. Results are discussed and compared to experimental observations.*

Keywords: pedestrian and crowd modeling; interdisciplinary approaches

Acknowledgement: This work is a result of the Crystal Project, funded by the Centre of Research Excellence in Hajj and Omrah (Hajjcore), Umm Al-Qura University, Makkah, Saudi Arabia.

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Modelling a Real Data Cellular Automaton to Analyze the Schistosomiasis Expansion Process Along the Coastline of Brazil

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Abstract: *This work presents a Cellular Automata model to characterize the social and environmental factors which contribute for the analysis of the expansion process of Schistosoma mansoni infection in Pernambuco - Brazil. The model has been experimented with real data from a study area at North Coast of Pernambuco – Brazil. The main constraint equations, the modelling process and the results obtained until now with the simulating scenarios generated are presented here. The results identify, as in field works, endemic areas and human risk infection areas.*

Keywords: cellular automata; Schistosomiasis; epidemiology; computational modelling

Acknowledgement: CNPq, CAPES, FACEPE.

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Agent-based Models in Malaria Elimination Strategy Design

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Abstract: *The present work evaluates the methodology to plan, communicate and discuss specific interventions to tackle malaria spreading by comparing three representative and deliberately simple epidemic models: A) an epidemic continuous model of the human population, B) a population-based model that accounts for both hosts and vectors, and C) an Individual-based model that considers the same scenario as in (B). The paper proposes a standard protocol and the use of open-source and user-friendly simulation environments to communicate and discuss the models.*

Keywords: agent-based models; Malaria, Epidemiology; computational modeling

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Agent-based Simulation Platforms: An Updated Review

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Abstract: *We review and evaluate two related agent-based simulation platforms: version 5.0 of NetLogo and the ReLogo component of Repast. We implemented the "StupidModel" series of 16 pseudo-models in both platforms; these codes contain many elements of basic agent-based models and can serve as templates for programming real models. Subsequent to the similar review we published in 2006, NetLogo has evolved into a powerful platform for scientific modeling while retaining its basic conceptual design, ease of use, and excellent documentation. ReLogo is a new component of Repast; it implements NetLogo's basic design and its primitives in the Groovy programming language embedded in the Eclipse development environment. ReLogo successfully reimplements much of NetLogo, and its translator was successful in converting NetLogo codes into ReLogo. Overall we found ReLogo considerably more challenging to use and a less productive development environment. Using ReLogo requires learning Groovy and Eclipse and becoming familiar with Repast's complex organization; documentation and learning materials are far less abundant and mature than NetLogo's. Though we did not investigate thoroughly, it is not clear what kinds of models could readily be implemented in ReLogo but not NetLogo. On average, NetLogo executed our example models approximately 20 times faster than ReLogo.*

Keywords: agent-based simulation platforms; NetLogo; Repast; ReLogo; template models

Acknowledgement: We thank Jonathan Ozik (Argonne National Laboratory) for assisting us with our model implementations in ReLogo.

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Symposium G. Observing Luhmann

Chairs: Eva Buchinger, Austrian Institute of Technology, Vienna, Austria, Manfred Füllsack, University of Vienna, Vienna, Austria

One aspect that distinguishes the Theory of Social Systems as proposed by Niklas Luhmann from other system theories is its attention for the observer-dependency of its issues. Particularly system theories with a strong background in physics often complain that the consideration of the observer condemns the Luhmannian theory to an infinite regress. Its applicability therewith is said to be limited. In terms of interacting complex dynamics however, the relationship of observer and observed can be seen as generating attractors which might prove stable enough to provide footing for further operations. Not only in this regard, the Luhmannian Theory of Social Systems seems to be reconcilable with more physically oriented system theories.

This symposium shall focus on possibilities and suggestions for such reconciliations, and in general, on attempts to apply the Luhmannian theory to empirical and quantitative research.

Manfred Füllsack: *Communication and Eigenform – Agents-based Simulations of Aspects of the Emergence of Communication*

Edmundo Balsemão Pires: *The Epistemological Meaning of Luhmann's Critique of Classical Ontology*

Karl Neumayer & Paolo Petta: *Towards the Development of a Conceptual Framework for an Applied Theory of Problem Structuring for Complex Agents: Questions to Luhmann's Social System Theory*

Eva Buchinger: *Observing Observers: Using Luhmann's Theory of Social Systems to Conceptualize Public Governance*

Gabriel Vélez-Cuartas: *Networks and SST Coupled to Map Science Evolution – A Structural Model to Map Social Systems*

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Communication and Eigenform

Agents-based Simulations of Aspects of the Emergence of Communication

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Keywords: communication; Eigenform; information; meaning; theory of social systems; multi-agent simulation

This proposal builds on results of experiments with a multi-agent simulation (MAS) model that simulates the emergence of a communicative system (hence a social system) as suggested by Niklas Luhmann (cf. Füllsack, 2011). Agents are conceived as "closed systems" using nothing else than their own on-board means to reciprocally couple to the actions of others and therewith to immerse into a symbol-mediated interaction which might be observed as communication by an observer (that is, as a three-fold selection process in the course of which information is understood as message, cf. Luhmann, 1984, p. 498). In other words, agents act as "black boxes" and mutually constrain their possibility spaces by way of selecting symbols in a way that leads to structural coupling.

My experiments show that communication when conceived in this way tends to run up in Lock-ins (Arthur, 1989) that differentiate the social system. Communication remains constrained to local subgroups. Obviously not all agents delimit their possibility spaces in the same way. Bifurcations in the early stages of the process of coupling seem to put them onto different pathways with no junction allowing for later alignment. Without additional mechanism, no common language and therewith no global communication emerges.

The proposal at hand tests such additional mechanisms, implements them into the model, and discusses them in the context of debates about meaning and a Unified Theory of Information (UTI, Hofkirchner, 1999). Shortly summarized, these debates focus on an assumed deficit of the mathematical (i.e. Shannon-) definition of information to comprehensively grasp information as used in human communication. In order to fill this deficit, usually an additional frame of semantic meaning is assumed with which Shannon-information (or pure data) is further enriched (a.o. Davis, 2002). Quite often however, this conception of meaning is conceived somehow extra-communicational, with aspects like its observer-dependency ("subjectivity") for instance or its implications for a difference of actuality and potentiality being regarded incomprehensible in terms of mathematical information theory - and, as a consequence, resistant to efforts of modeling. With this, in some sense, meaning seems to be regarded beyond the horizon of scientific formalization.

Far from claiming an implementation of proper meaning into the MAS-model (as described above), the proposed paper will try to show that a simple higher-order structure of frames around the emerging communicative system can induce agents to "reconsider" their differentiations (that is, their particular ways of delimiting possibility spaces) in order to integrate the differentiations of others. This can alter the system's dynamics so that agents eventually "convene" on one common (global) language.

Considering this possibility on the background of the Luhmannian conception of meaning (cf. Luhmann, 1984, p. 92ff), the following propositions are discussed: 1.) Meaning, as we commonly see it, can be regarded (in the same sense as communication above) as an emergent property of the (local) interaction of a multitude of autonomous agents that act as closed systems on nothing else than their own on-board means, but successively constrain their possibility spaces in reciprocal interactions and therewith coordinate their actions. 2.) Hence, meaning (or at least certain aspects of it) might be seen as a consequence of the advantage of the possibility to coordinate a multitude of instances in a way that is simultaneously stable and sufficiently adaptive for to react to (possibly self-generated) perturbations. 3.) Thus, in respect to considerations of von Foerster (1981) and Lou Kauffmann (2009) meaning can be seen as Eigenform of the interrelations involved in this process of interaction. Consistent with the concept of *strange attractors*, this Eigenform does not denote one particular instance of meaning, but rather delimits a probability space within which meaning can float to certain extents, therewith remaining adaptive to changes of context. 4.) With this, in spite of the implied fuzziness, this conception of meaning (at least in regard to the aspects addressed here) could principally be grasped in terms of Shannon-information as well, that is, as a particular selection from a (finite) repertoire of conceptions that accomplishes coordination with the specific ratio to the potential candidates in this repertoire that are not selected. This however implies that 5.) meaning might need some kind of frame in itself and therewith might run up to the same kind of problem. The peculiar and often-mentioned limitlessness and "otherlessness" of meaning (nothing is conceivable without meaning, cf. Luhmann, 1984, p. 96) might stem from the ensuing sequence of higher-order meanings which, according to respective assumptions, therewith should contribute to the specific Eigenform of meaning.

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The Epistemological Meaning of Luhmann's Critique of Classical Ontology

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Abstract: *My contribution for the Meeting aims the discussion of the possibility of a concept of World compatible with the "operative constructivism" and the operative conception of observation of the Theory of Systems, according to Luhmann. I'll explain my views through the examination of the concepts of observation of von Foerster, Maturana, Günther and Luhmann providing the general framework of the "operative constructivism". The paper will focus on Luhmann's understanding of the role of observation in the constitution of the self-reference of the social systems of the modern society functionally differentiated. The case of the System of Art will be scrutinized.*

Keywords: observation; second order observation; operative constructivism; Luhmann; system of art

Die Gesellschaft hat also, so können wir zusammenfassen, kein Wesen. *(Luhmann, Die Gesellschaft der Gesellschaft, 1995, p. 89)*

My contribution for the Meeting aims the discussion of the possibility of a concept of World compatible with the "operative constructivism" and the operative conception of observation of the Theory of Systems, according to Luhmann.

1.

I'll try to show how the "operative constructivism" brings new tasks to the research focused in traditional ontological themes, such as individuality or modalities, but also in cognitive issues, especially those connected to social philosophy.

In the philosophical tradition the concept of World implied a sequence of related concepts amongst which the notions of substance and being, thing, individuated thing, actual and possible existence, totality and collection, stability of properties, etc.

In the case of traditional Metaphysics all these notions referred to something "at hand", that "was there", independent of the observer.

As a consequence of the post-Hegelian Philosophy has began in the West a critique of the old concept of substance, or *res*, and also a reasonable rejection of the naïve postulation of an independent World, outside the process of Knowing. Pragmatism and Phenomenology were also significant movements that went in the same critical attitude.

When Luhmann introduced his version of the "operative constructivism" he was faithful to the post-Hegelian, Pragmaticist and Phenomenological destruction of the concept of World as "universitas rerum".

What place shall we concede to the idea of an "objective" world, according to Luhmann? Are Systems "objective"? Or are they neither objective nor subjective?

If we remain faithful to Luhmann, we should say that only operations are “objective”. However, an operation is not an entity, which means that, at the “operative” level, we are facing a new kind of “ob-jects”, very different from the “thing-objectivity” of the ancient Metaphysics that remains in the common-sense construction of Reality. These questions were at stake in the following formulation of *Die Gesellschaft der Gesellschaft*: Society is “weder Subjekt noch Objekt”.

We need to explore the consequences of such paradoxical “weder Subjekt noch Objekt” conception of reality.

I will discuss the meaning of Luhmann’s epistemological proposal through the explanation of his concepts of World, Observation and second order Observation. I’ll justify my approach to Luhmann’s conceptions through a reassessment of von Foerster’s second order Cybernetics, Maturana’s concept of Observation and G. Günther’s Policontexturality.

2.

The idea of a “substratum” independent from operations and distinctions is just an observer’s epistemological resource so that he / she can give continuity to descriptions and to be able to move on “from a moment to the other”, according to the reality mode. Instead of the objectivity of a real, independent “substratum” it is preferable to talk about the “observer’s ontology”. This thesis is common to von Foerster’s, G. Günther’s and H. Maturana’s conceptions of observation.

The first author revealed how the object is only completely postulated and constructed when the observer makes a re-entry of a first observation; G. Günther established the principle of a plurality of reality levels he called contextures and the later conceived observation as a result of the cognitive and linguistic strategies of the living.

N. Luhmann’s starting point in the elaboration of his own doctrine of social systems and in the revision of the classical doctrine of systems is based upon the conceptual triad of *operating and structural closure, cognitive openess* and *self-reference*.

In *Das Recht der Gesellschaft* the conception of “operative closure” leads to a particular distinction between operation and observation.

This difference is internal to the system itself in its functioning and in its own structural arrangement. Observation is, then, an operation of the system itself. Thus, observation is not a state of consciousness or a psychic exclusive mode of the organization of the experience.

The central thesis was, in this respect, quite clear: *the concepts of observation and self-reference are reciprocally implied*.

N. Luhmann states that the “operative closure” of partial systems based upon communication is only adequate to the form of modern society’s communication.

This idea implies a connection between the *form of social differentiation,* the *type of systemic autonomy* and *observation.*

In my paper, I’ll discuss this last aspect, also, mobilizing the theme of the second order observation in the case of the System of Art of modern Society, functionally differentiated. With some exemplification I’ll explain Luhmann’s ideas in the second chapter of *Die Kunst der Gesellschaft*.

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Towards the Development of a Conceptual Framework for an Applied Theory of Problem Structuring for Complex Agents: Questions to Luhmann's Social System Theory

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Abstract: *We provide a snapshot of our development of a principled approach to corporate strategy consulting motivated by the need to improve the quality of strategic decision making of enterprises as complex agents. We propose a paradigmatic reconceptualisation of the foundations of decision making in terms of processes underlying Problem Structuring, with implications for the identity of complex agents, the notion of rationality, and the shaping of decision processes. The two interrelated main components are the transpersonal Weinhaus conceptual modelling framework and a structured method for the development, implementation, and verification of practical sound interventions. We formulate questions to Social Systems Theory to review our achievements.*

Keywords: corporate strategy consulting; enterprise modelling; transpersonal modelling; action theory; theory of social systems; reflected behaviour

Acknowledgement: This research is supported in part by a FFG Forschungsscheck awarded to KOGNOS GmbH: The basic conceptual framework of the Weinhaus Model is an original contribution of the first author. The Austrian Research Institute for Artificial Intelligence is supported by the Austrian Federal Ministry for Transport, Innovation, and Technology.

1. Motivation

The complexity of the activities of enterprises has been steadily increasing. A next challenge is to move from a view of punctate "re-invention" towards managing a process of *continuous* adaptation to multiple and interacting spheres of influence. Management theory has to model what such modern organizations do and are to do; what is particular about the challenges they face; and how this domain and its processes can be grasped in a structured manner. Our further requirement is to derive and implement principled *interventions* bringing about measurable performance effects.

We see as a main cause for the limited explanatory potential of today's decision theoretic approaches that they set out from an undifferentiated and overly simplified concept of Agent (cf. Luhmann 2000, p.7ff; Chiles et al. 2010, Mathews 2010) reflecting an overly narrow definition of its environment/field of activity. Our proposal is rooted in a shift of perspective towards a trans-individual systemic view that analyses agents as aggregates of environmental elements/ resources; it has been developed from a mainly action theoretic perspective. Our aim is to develop an efficient tool for the strategic orientation of enterprises. Rather than the development of simulations, our immediate goal is to enable a more encompassing *and* more specific understanding of the realities of a given enterprise client. Our main target of analysis is not the routinised *acting* of the *firm*, but the reflected *behaviour* of the *enterprise*. A first contribution is the development of a principled and pragmatic framework subserving a coherent methodology for corporate strategy consulting. We base our approach on a notion of problem structuring that extends the scope of traditional approaches to decision theory by including explicitly conditions hitherto considered as exogenous: concurrent memberships in *multiple* cultural *and* social contexts. Within the materialisation of the *entrepreneurial will* constituting the company, these multiple *identities* interact in defining premises for decision processes, replacing the traditional given of *static problem framings* by a continuous process of *problem structuring*. This has pervasive consequences on all dimensions of decision-making, shifting the focus of analysis from (meaningless) *acting* of a firm to (meaningful) *behaving* of the enterprise, exposing components and influences suitable for the formulation, implementation, and verification of effective consulting interventions.

2. The Weinhaus Conceptual Framework

We characterise the *enterprise strategy* process as: 1) having the purpose to verify and revisit the *entrepreneurial will* statement, from which fundamental criteria of *relevance* are derived: it produces and is itself based on guiding principles and rules; 2) a *continuous process* providing the *pragmatic frame of reference* for all activities of the enterprise, in particular the formulation of problems; 3) of *comprehensive scope* and providing explicit documentation of the reasons for exclusion of any potential areas of activity. It provides the frame of orientation describing the enterprise *with* its environment. As the basis for the detection of *differences from ideals* currently upheld, it enables *formulation* of problems and planning of solution approaches: Strategy is foremost a process of self-discovery. Our method to assist in the definition and maintenance of the *strategic horizon* of an enterprise is based on the notion of *Strategic Balance*™[1]. The Weinhaus Model is our categorical framework to describe the world of corporations and corporate activity the strategy process is situated in: It provides the theoretical and conceptual underpinning for the modelling of the strategic dimension of decision and action of enterprises as *Complex Agents*.

We categorise real Agents by increasing strategic complexity and autonomy: *trivial*; *reflexive*; and *self-reflexive* (complex) agents. The latter can develop higher level strategies and adapt their multi-faceted behaviour reflecting *multiple evolving world views*: each of such Agents' multiple *identity systems* (IS) comprise an evolving consistent *internal model* (IM) supporting a particular *world view*. A particular configuration of an IS at a given moment is an *identity version* (IV). A key aspect is the *trans-individual scope* of a self-reflexive agent's world modelling (cf. Bateson 1972): The utility functions underlying evolution of IMs need not reflect basic concerns of the agent itself, but of other agents, agent groups, or properties and characteristics of the environment. The process of *adoption* and *development* of ISs is embedded in the agent's *society*, supporting its differentiation into constituting *Culture Systems (CS)* and *Social Systems (SS)*.

We analyse Self-reflexive Agents' activity in terms of causal contributions of the hypothetical constituting ISs. The challenge for Self-reflexive Agents is to coordinate these interactions between ISs through the development of explicit conceptual internal models (IMs) for these ISs. Agent's overall characteristic pattern of decision making results from the interplay its active *interests* (cf. Köhler, forthcoming) and the *intelligence bases* of the available IMs. From a global point of view, Agents are embedded in networks of practices in which *organisational closure* achieved by *autocatalytic processes* leads to informational differentiation of webs of particular identities (Juarrero 1999). From their subjective local point of view, complex Agents interact with their environments in pursuit of existential self-interests based on their specific IVs and related problem structuring utilities. For observers, this is reflected in identifiable patterns of interaction between IS. We refer to the totality of these patterns as *Culture Systems* (CS). To establish and sustain CS, shared norms and routines, and formalised interaction policies, emerge or are adopted from other already existing CS. We refer to these bodies of dependable procedures, promoted by CS and in turn contributing to the resilience of CS, as *Social Systems* (SSs) (cf. Eigen & Schuster, 1979).

[1] (Karl Neumayer, KOGNOS).

Even though these concepts are modelling artefacts, belonging to and attributed by an observer, CSs do effectively shape the reality of Complex Agents, as they frame their problem structuring processes and form the *contrast spaces* from which a course of action is then selected, taking into account the conditions set by the mechanisms of the supporting SS (cf. Juarrero 1999, pp.181ff). Enterprise Agents in particular should aim to improve the functional balance across their selective participation in multiple CSs. We see a key challenge for strategy consulting to provide effective support in this process of overarching constructive reflection (cf. “double closure” in Luhmann 2000, 228f). We conceive identity in more differentiated manner, as integration of multiple transpersonal *versions* of identity (cf. LeBoeuf et al. 2010). In our consulting approach, we derive a *hypothetical model* of an enterprise’s *real* internal organisation, constrained and informed by the conceptual building blocks of the Weinhaus Model and their formal interdependencies, but also by the “constructivist potency” of the observing consulter. Note that such models remain necessarily incomplete: the incremental development includes positive and negative stopping conditions.

3. Implications and Challenges/Research Perspectives as Discussion Contributions

We do find some agreement with Parsons’ AGIL framework: regarding the basic entities of organism, personalities, social systems and cultural systems, and even more regarding identified *challenges*, such as the dynamics related to reconciliation of internal and external environments—formulated as the “problems of integration and adaption” (e.g. Parsons 1960, pp.473ff). Parsons’ analytical work thus provides interesting opportunities for reflection on our own effort aimed at the development of a practical principled method rather than a theoretical systematization. While the scope of e.g. Parsons’ AGIL model is limited to static and separate modelling, we pursue a consistent trans-personal approach, motivated by and aiming for interventional consequence.

This motivates our strong interest in Luhmann’s theorising, which we will capture in a selection of exemplary questions (cf. e.g. Stichweh, 2002; Luhmann 1984, pp.235 and 638ff. on action theory; Luhmann 2000, pp. 172 and 244ff on *values* as the core (“Letztkomponenten”) of organisational culture): Even if “partial adoption” of identified answers and integration of Social Systems Theory into a *hybrid* methodological *tool* should not be an option (Schoeneborn 2011, p.681), improved awareness of the boundaries and deeper appreciation of the deliberate reifications of our model are essential for its productive application in our consulting activity.

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Observing Observers

Using Luhmann's Theory of Social Systems to Conceptualize Public Governance

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Abstract: *The idea that observers are themselves objects of observation is nowadays widely accepted. Such reality-construction is labeled second-order observation by the sociologist N. Luhmann and builds on the work of cyberneticians such as H. v. Foerster, G. Bateson, M. Mead and the neurobiologists H. Maturana and F. Varela. In public governance, the observation of observers is a basic principle. Steering subjects (elected politicians) as well as steering addressees (e.g. companies, universities, hospitals) are observing each other in their performance to contribute to a certain policy target. Both parties are observed by professional observers such as statistical offices, analysts/evaluators, and mass media. The empirical relevance of observing observers in public governance will be shown by the example of the research & development target of the European Union.*

Keywords: observing observers; self reference; policy making; steering cycle

1. Observation: Basic category and second-order observation

The idea that observers are themselves objects of observation is nowadays widely accepted. The background for this idea has been provided by Maturana's theorem number 1 "anything said is said by an observer" and Foerster's corollary number 1 "anything said is said to an observer" (Foerster, 1979, p. 1). This reality-construction labeled is second-order observation – or previously – second-order cybernetics. "I would say, first-order cybernetics is the cybernetics of observed systems, while second-order cybernetics is the cybernetics of observing systems. […] One considers oneself: on the one hand, as an independent observer who watches the world go by; or on the other hand, as a particular actor in the circularity of human relations." (Foerster, 2003 [1991], p. 303)

The treatment of observation in Luhmann's theory of social systems is based on second-order cybernetics (Luhmann, 1989 [1986], p. 23). He emphasizes that "observation means nothing more than handling distinctions" (Luhmann, 1995 [1984], p. 36). According to that it is important to have in mind that the

- observing-observer (=observer) and the
- observed-observer (=actor)

do use each an individual set of distinctions. Since observers and actors are conceptualized as operationally closed systems, their self-reference and other-reference schemes must be considered in this respect (fig. 1). Accordingly, there are differences in their observation schemes. Hereby the main difference between their observation modes is (Luhmann, 1989 [1986], p. 25): (i) the actor perceives himself primarily in the situation itself, and (ii) the observer focuses on the actor-in-the-situation (e.g. the observer looks on the differences in the interpretation of the situation by different actors) (fig. 1 and 2).

2. Public governance: First-order and second-order

An attempt to distinguish first-order governance from second-order governance has been made by J. Kooiman (Kooiman, 2003, p. 135-169). He explains first-order governance as “day-to-day problem tackling/opportunity creation” and second-order governance as “care for and maintenance of relevant institutions in which first-order governance is embedded”. This approach is appealing from a general sociological point of view, but one step ahead from a specific cybernetic perspective. Yes, “institutions matter” (Williamson, 1996), but which one in which situational context? The observation of observers must be more precisely to capture the “circularity of human relations”. Since institutions represent the “stability of normative pattern” (Parsons, 1982 [1960], p. 260) on the societal level, they only provide a framework for, but do not reveal, individual reality-constructions, expectations, actions etc. Therefore it is necessary to take a step back to the level of actors.

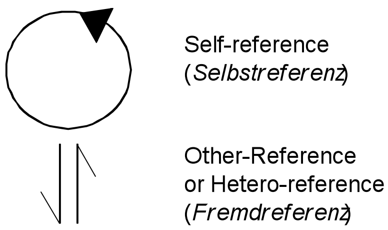

Figure 1: Referential categories of operationally closed systems (Buchinger 2007: 179 by adopting a symbol from; Maturana and Varela 1992: 74)

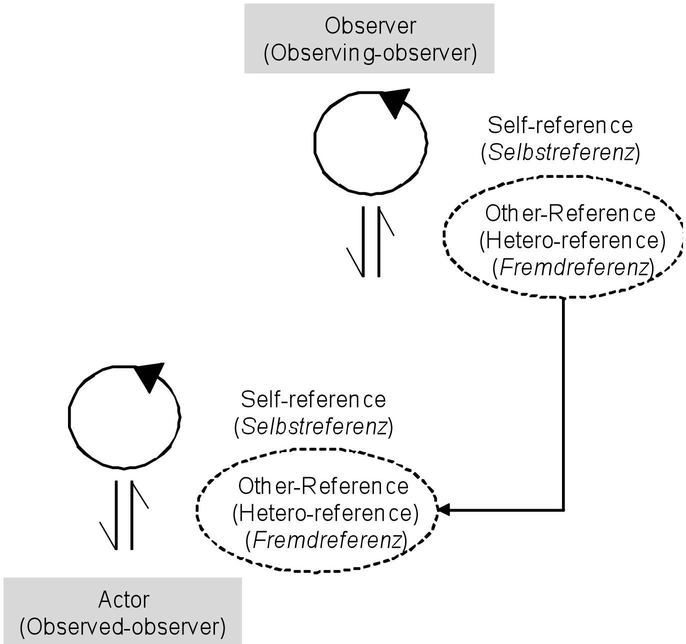

Figure 2: Second-order observation

The modeling of public governance on actor level follows the second-order idea that steering-subjects are “part of the game”. An early discussion of observer-inclusion was contributed by Gregory Bateson and Margret Mead (Brand et al., 1976). In analogy, public governance is idealized as a steering cycle including actors in form of organizational systems. Steering-participants – i.e. steering subjects & addressees together with other actors – form a process of observation-based-interactions and a circular process emerges therefore.

Based on the integration of social-systems-theory and role-theory (Merton, 1996 [1957]), the public-governance-model distinguishes between actors[1] and roles; i.e. actors are attributed to a 4-role-set: steering subjects, steering administrators, steering addressees, and steering observers.

[1] In this case only of organizational actors, but the basic principles apply also for persons as actors.

Therefore, one actor can act in more than one role. This allows for two levels of circularity-treatment – actor-specific and role-specific. Exactly this differentiation is major issue in governance debates (i.e. new public governance, distributed public governance) (EC and OECD, 2007; OECD, 2002) .

This draws the attention to that fact that all – or at least potentially all – steering-participants are both – actors and observers. Maybe only one group of observers remains singularly in the second-order-observation role – namely professional observers such as analysts, evaluators, and mass-media. All the others are acting as both – observed-observers (actors) and observing-observers (observers). These are steering subjects in form of elected politicians, steering administrators in form of policy makers (not elected civil servants and the related agencies), and – last but not least – steering addressees in form of companies, universities, schools, hospitals, NGOs etc.

3. Application: Observing observers in recent policy making by the example "R&D target"

On basis of an empirical example it can be demonstrated in which way the observation of observers intermingle in cyclical policy processes. As example for that serves the research and development (R&D) target within the European Union. In their role as steering subjects, the European institutions (parliament, council) agreed on achieving a target of spending 3% of EU GDP on R&D by 2020. This spending is generated by the public as well as by the private sector. Therefore, steering addressees in form of tech-companies, universities and other concerned entities are carefully observed concerning their behavior to contribute to this target. This careful observation is done by steering subjects, steering administrators (above all responsible ministries in the EU member states and their agencies) and professional observers in form of statistical offices, economists, political-scientists and mass-media, whose observation-distinctions differ with respect to their primary orientation towards either political, or scientific or mass-media rationality. Since also public money contributes to this target, steering subjects and steering administrators are observed from all the others concerning their activities. Hereby, companies will use observation-distinctions according to their economic rationality (profits, being able to pay). This is again different from observation-distinctions, which are used by scientific steering addressees, aiming at publishing, reputation and/or patenting. By this example it can be shown that observing observers is not only an interesting cybernetic & system theoretic concept, but also a powerful tool for describing and analyzing ongoing public governance.

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Networks and SST Coupled to Map Science Evolution

A Structural Model to Map Social Systems

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Abstract: *Meaning as an emergent phenomenon is composed by two constructive processes according to Luhmann's SST. The first refers to personal experience: memories and choices experienced by consciousness. The second is related to cumulative social experience as a horizon of possibilities . These possibilities make communication possible.. This work presents an exploratory model that depicts meaning as a process of cumulative experience enacted by signs or information organized in networks of communications. Communications in this sense are enunciations that imply thematic issues interconnected through words and other kinds of situational information that can be perceived. If we classify the types of information exposed in a social communicational event it is possible to find repetitions and variations of information from past events. Communication events related through occurrence and variation can be depicted in networks. If social systems are codified as Luhmann suggests, we could find structures of information that imply genealogies that express the continuation of autopoietic processes in systems This paper aims to demonstrate how the scientific social system, understood as a system of communication events where thematic issues emerge, could be mapped through juxtaposed networks of different kinds of codified information.*

The following case exemplifies recent studies of the developments in the social network analysis field Meaning networks are applied as tools for the indexation of thematic issues using network analysis and social systems theory.

Keywords: meaning networks; social systems theory; communication theory; scientific communication

This paper argues that meaning dynamics could be represented through network analysis. We aim to demonstrate that analytical principles that have been developed in graph theory, set theory and/or calculus and algebraic matrices can be usefully applied to the representation of meaning. For our purpose, we will start by examining two basic principles: aggregation and distinction. The first principle, aggregation, comes from set theory. A set is an aggregate of elements arranged according to one or more rules that define boundaries and possible operations between these elements. The second principle, distinction, has been recently developed by George Spencer-Brown (1977). This mathematician proposes a set of axioms and theorems to define an operation that is previous to aggregation. In the introduction to "Laws of Form", Spencer-Brown argues that the introduction of the concept of distinction would resolve logical paradoxes in the definition of a set (already discovered by Bertrand Russell at The Principles of Mathematics, 1938)[1].

The cognitive operation of distinction is different from the cognitive operation that defines a well-ordered set. A well-ordered set supposes that reality shows itself to a rational and perfect consciousness. This kind of consciousness could define perfectly all those necessary conditions of aggregation to identify structures, organization forms and possible relationships (Cantor, 1915). Opposed to this point of view, a distinction emerges from a constructivist dynamic between observant and observees, where observees elements change meanwhile the observant is trying to

[1] If we try to represent dynamics from self organized systems, paradox is always present in their operations. For instance, if we take a social system (understood as a system of communications), an event of communication is a selection of information of past events pointing their equivalence to be understood but always been different. This is why a representation of communication as a set of events always will have elements that belong to that set and at the same time different from it.

simplify its dynamics to its own changes to couple, to assimilate or to destroy such an element (exactly as Francisco Varela pointed out, 1998).

If we combine the principles of aggregation (from Cantor) and distinction (from Spencer Brown) we will have the possibility of modifying certain ways to borderline a kind of evolutive dynamic in the definition of sets. This means that representations of sets could consider elements present into two different sets at the same time, depending on distinctions associated to that element. With the introduction of distinction, elements could be paradoxical if we use theories of evolution and closed systems.

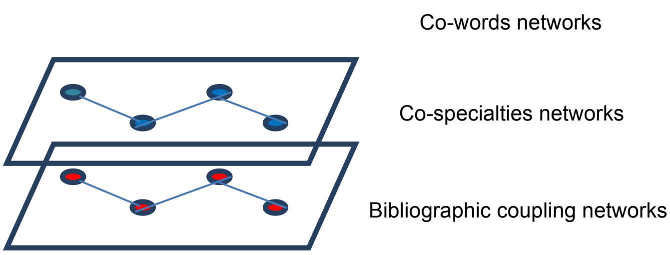
Once aggregation and distinction as principles had been defined we have to introduce the concept of relationship. A network is a set of points linked by some kind of relationship. If we understood that identity of elements is determined from a structural point of view by their relations (or from a systemic point of view by their operations), we would not locate identity paradox in the elements but in their relationships. This means that paradox may be solved if we find a representation form that accepts elements from a set that can be related with different elements that permit define their identities from different point of views.

Cognitive principle introduced by distinction open a dialogue between observant and observee elements. First, observant aggregates elements from a first distinction. Then, by discovering relationships between elements, for example, co-presence of elements in different events that can point a link between them (in form of a network). These relationships make able a further distinction that aggregate elements according to common characteristics. These elements belong to different aggregates although they remain the same in identity. If we consider these elements as parts of events we will be able to infer some kind of self-dynamic that is organized by an observant that tries to formalize external behaviors according to its cognitive abilities.

There are three remarkable things that could be outlined from these assertions. First one is that we are assuming that interconnected events by co-presence in the realm of social things could be already interpreted as social dynamics. From Luhmann's (1998) social systems theory, we could find that continuity of communication events could be expressed empirically as forms of selection/variation/stabilization due to meaning dynamics: selection from previous events, variation as new forms of the same contextualized, and stabilization as duration. Stabilization describes time, and selection and variation cluster events. Second, as events or as elements of a set we are considering entities that are aggregated because they belong to a dynamic system; in Loet Leydesdorff words: in an empirical study, system always remains as a hypothesis (Leydesdorff, 2001b). With this consideration, we have to relate selection processes as structural ones, exactly as Luhmann (1998) proposes in chapter 8 of Social Systems (Structure and Time). Then a system operates in a structural form taking past events as references. In this way, the emerging of new events consider past information that has been communicated in a new form. Third, it's possible to consider one event as a multi-layered entity that contains different forms of information. This means that a communication event is composed of multiple marks or units of information, which together give meaning to that event.

For instance, if we have a set of elements defined as key words from a file of scientific papers related with a scientific issue or specialty, we could find that many of these words repeat themselves in different articles. These key words presented as a relationship of co-occurrence give some primitive (or imprecise) meaning to a group of events. But aggregating another kind of information presented in different events and linking it by co-occurrece as references and specialties, meaning could be specified. Schematically, this can be represented as follows in figure 1.

Figure 1. Communication events as multi-layered networks.



Argumentation in science, according to Luhmann (*Die Wirtschaft der Gesellschaft,* Translated to Spanish as “La Ciencia de la Sociedad”, 1996) operates through three main components: prestige, clarification and specialization. These three components are composed by scientific concepts as transversal operators. If we try to represent these as information contained in papers (named as communications) we will tell that the task of argumentation is to build concepts. Scientometrics has specified denominations to obtain operations of argumentation: prestige associated with volume of cited references (see De Solla Price, 1973 [1963]), specialties as journals subscription to different fields (see for instance L. Leydesdorff analysis, 2001a) and clarification[2] could be related to evolution of aggregated words in subsets of thematic issues combined with their genealogies also called invisible colleges (see De Solla Price, 1973 [1963]). Each one of these kinds of analyses could be represented in networks. Juxtaposition of these networks could specify meaning in a set of texts.

In summary, network analysis could be used as a tool of representation transforming some principles of set theory, changing some procedures in matrix disposition of elements according to Spencer-Brown’s distinction logic. This derives in juxtaposed networks linking communication events thinking in a structural disposition of systems, whether we understand structure as events genealogies of kinds of information.

The case of *Social Networks Analysis* field will be presented through 487 articles taken from the most representative journals in English and Spanish, like Social Networks (from Elsevier) and Redes: Hispanic Review for Social Network Analysis (from Autonomous University of Barcelona). Juxtaposed networks were depicted. Their analysis let us discover beyond descriptive analysis features of *limitationalität*[3]*.*

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[2] Although there is not a logic method inside Scientometrics to represent debates, there is an exception in the model of discourse synthesis presented, for example in a compilation made by Raymond McInnis (2001).

[3] A concept proposed by Luhmann in Die Wirtschaft der Gesellschaftthat describes boundaries of theories from a second order analysis.

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PhD in Social and Political Sciences (tutored by Dr. Javier Torres Nafarrate, main translator to Spanish of Niklas Luhmann works). Master in Communication Studies (Monograph made on Interorganizational Networks). Assistant professor of Sociology Department at University of Antioquia (Colombia).Director of Social Networks and Actors Research Group (this group has been recognized by Administrative Department of Science, Technology and Innovation, Colciencias –equivalent to a National Governmental Council for Scientific Research). Member of Scientific Committee of Redes: Hispanic Review for Social Network Analysis (main diffusion media for Social Network Analysis in this language). Memberships: International Sociological Association: RC51, RC23 and RC33; International Network of Social Network Analysis (INSNA). Production: 24 publications, 32 conference papers and 10 research projects besides teaching experience on research and consulting. Issues developed are associated to the improvement of tools for social network analysis (in the fields of interorganizational networks, policy networks and science mapping), social systems theory and communication theory (communicology). Two different models have been created: Structural Performance and Meaning Networks. First one is based on Giddens Structuration Theory and network analysis is applied to different levels and dimensions to interorganizational analysis. Meaning Networks is the model presented at this session using Social Systems theory applied to network analysis of scientific production.

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emcsr 2012 european meetings on cybernetics and systems research

Symposium I. Professional Systemics

Chairs: Nikitas Assimakopoulos and Dimitrios Varsos, University of Piraeus, Piraeus, Greece

The Symposium's aim is to stimulate an energetic exchange of systems approach perspectives in the area of Professional Systemics applied effectively in organizations and enterprises across a wide spectrum of both service and production industry sectors.

The traditional organization is designed along a hierarchical structure in which activities are organized along common areas of responsibility. Key processes are defined and controlled within strict functional boundaries, with minimum attention given to systemic interaction. Business decisions are derived through analytical methods which involve the determination of the meaning of what is studied in the context of a reductionist approach: reducing the whole into its constituent elements, understanding each element separately and aggregating understanding of the individual elements into an understanding of the whole. Given the dynamic complexity of the today's business environment and the continual exchange of its constituent elements, application of the reductionist method typically results in the loss of the essential properties of both the system studied as well as of its parts. Hence, business decisions lack cohesion, and management, the ability to align activities to effectively achieve the company's long-term strategic objectives.

Systems thinking is fundamentally different from the reductionist method in that it focuses on the understanding of how and why various elements affect one another within a defined unified whole. A systemic approach concentrates on the understanding of the interactions of the constituent elements of a system that produce a behavior rather than the segregated parts of the system, studied in isolation. The need for a systemic approach has never been more imperative, given the realities of the new economic climate impelled by the current credit crisis and the need for organizations to challenge existing paradigms, core values and business assumptions against the dynamic complexity of a volatile economic environment.

Professional Systemics is the practical application of systems thinking to everyday situations. It is a means through which to handle complexity in a manner which has achievable, measurable and realistic results.

Professional Systemics bridges the gap between theory and practice and promotes the use of effective systemic Methodologies and Multi-Methodologies in managing today's dynamic organizational complexity.

Stergiani A. Giannakou & Dimitrios S. Varsos: *Implementation of Professional Systemics in a European Public Organization for Medicines*

Rainer Born & Eva Gatarik: *Applied Systemic Thinking in Real-life Business: Thinking Together and Learning from Each Other in Practice*

Douglas Torres: *Cybercrime in the Bolivarian Republic of Venezuela: a Systemic Perspective*

Nikitas A. Assimakopoulos & Dimitrios S. Varsos: *Establishing a Systemic Foundation: the Required Structure on which to Implement a Systems Approach to Managing Dynamic Complexity*

Alexey Anokhin & Edward Marshall: *Adaptive Human-System Interface for Control of Complex Systems (in Application to Nuclear Power Plant)*

Douglas Torres: *Internet Access as a Fundamental Right and Progressive Expression of Human Rights in Venezuela: Systemic View*

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Implementation of Professional Systemics in a European Public Organization for Medicines

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Abstract: *In the recent economic, social and political environment, there is an increasing recognition at European level that public agencies have to improve and modernize their services, through the use of innovative tools and management techniques and develop their culture management, in order to satisfy the needs of citizens and society.*

In the present study, the management decision processes of Greek Authorities for Medicinal Products (EOF) are presented, analyzed and challenged, on the basis of their efficiency and performance at different levels and in different areas, as nowadays, it is essential to ensure that the Organization is on track relative to its ability to achieve its objectives and targets, and to provide a basis for continual improvement. System disconnects which led to ineffective operational activities were explored and their underlying causes identified.

Finally, different methods and techniques were designed, in order to provide a unique system within the Organization, which will be continually evaluated and improved in light of its efficiency, effectiveness, and flexibility.

Keywords: dynamics; strategic planning; National Organization for Medicines; professional systemics; Design and Control Systemic Methodology (DCSYM); Vensim

1. Study background - National Organization for Medicines (EOF)

The National Organization for Medicines (EOF) was established in 1983, with Act 1316, and is a public entity, which operates under the responsibility of the Ministry of Health and Public Solidarity. EOF is administered by a Management Board. The Organization's present structure was established in Presidential Decree 142/89. It has 9 Divisions. EOF is responsible for the protection of public health and the promotion of the general well-being of the citizens.

EOF contributes to the National Economy through its mandated scope, which is to evaluate and authorize new health related products, monitor the post-marketing quality, safety and efficacy of these products, monitor product manufacturing procedures, clinical studies and the marketing of products, in order to ensure compliance with good manufacturing, laboratory, and clinical practice, as well as with the existing legislation regarding the marketing, distribution, commercialization, and advertising of pharmaceutical products. Further, EOF develops and promotes medical and pharmaceutical research, and provides health professionals, Competent Authorities and the general public with reliable information as it relates to pharmaceutical (for human or veterinary use) and other health related products, in order to ensure their responsible use and provide an assessment of their cost-effectiveness.

2. Organization's Environment – Interested parties

There has been increased recognition that public agencies have to improve and modernize their services through the implementation of advanced management tools and techniques, in order to satisfy the needs of their stakeholders.

EOF operates in the pharmaceutical framework, consisted of the European Medicines Authorities (EMA), EU Council & Committees, Member States' Medicines Authorities and domestic, European and international: pharmaceutical industry and companies, hospitals, health care professionals, importers/ distributors, Ministries and citizens – patients.

These parties are organized along an integrated strategy aimed at creating a unified pharmaceutical market intended to promote a high level of public health.

3. Objectives of the study

In order to fulfill its mandated scope both on a national as well as a European level, EOF needs to create an environment in which its strategic objectives are balanced with its operational initiatives.

This will be accomplished through a strongly integrated planning system with rigorous analysis of the environment using a range of tools and methodologies. Objectives and targets should clearly be related to the issues identified and carefully be chosen to achieve the strategic goals. Results would indicate that objectives and targets are being measured and reported to top management, and reporting should demonstrate that targets are being met or adjusted when necessary.

Strong links should be created between the strategic plans, annual work programme, department plans and individual staff plans.

The deployment of innovative management tools and sound methodologies / multimethodologies will allow the Organization to better manage the complexity associated with its core processes within its policy boundary.

4. Approach - Quality Improvement issues

In the present study, the implementation of an efficient Quality Management System (QMS) based on Professional Systemic concepts and methods, is suggested, in order to support EOF in achieving the goals and objectives set out in its policy and strategy. Through this approach, consistency in terms of methods, materials, equipment, etc., will be provided and interaction with all activities of the Organisation, at every interface will be addressed. All EOF's systems and processes should be designed to fulfil the customer's quality requirements and applicable regulatory requirements, while aiming to enhance customer satisfaction and achieve continual improvement of its performance in pursuit of these objectives. Strong links should be created between the strategic plans, annual work programme, department plans and individual staff plans.

To this end, a systemic approach to managing the Organization's operating complexity is presented, defining the interrelationships between the various elements of the System (EOF and its environment) and placing the elements in a context that reflects EOF's commitment to Quality. The various elements that comprise the Management System illustrate a coordinated effort, and a systemic quality plan. A number of tools are utilized through which strategic planning initiatives are explored. These tools include the Design & Control Systemic Methodology (DCSYM) platform, which depicts the interrelationships between the organizational units, and dynamic modeling software Vensim of Ventana Systems Inc. (Harvard, Massachusetts) though which relationships are explored and the impact of future decisions evaluated.

Additionally, a graphical representation of the Organization's key processes are presented and studied for the purpose of discovering procedural disconnects and identifying systemic interaction, which will lead to enhanced process control, resource optimization and system improvements.

5. Results

Through this approach, the emerging opportunities and failures within and across the Organization's functions were identified and explored. Disconnects between the various elements of the system were identified and studied for the purpose of determining systemic relationships and interdependencies. The main cause identified for the lack of systemic coherence in the Organization's system was ineffective communication channels which encouraged the various organizational units to operate in a state of "functional isolationism". Through this work a systemic approach is encouraged in addressing system coherence and strategic decisions are suggested and their impact evaluated both on the Organization's short as well as long term operational capability. These decisions will impact the Organization's ability to provide services which reflect a posture of excellence relative to its mandated scope.

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Applied Systemic Thinking in Real-life Business: Thinking Together and Learning from Each Other in Practice

„Human history began with an act of disobedience, and it is not unlikely that it will be terminated by an act of obedience." (Erich Fromm)

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Abstract: *We shall start with the description of a successful enterprise where systemic thinking is an explanation of its sustainable economic success. What we have found is that isolated solutions (local optimization) do not work and the success in this enterprise rests upon dialogue, mutual correction, talking to each other and taking care of each other. What is essential – just in terms of systemic thinking – is that the success of the whole firm is definitely more than the sum of the success of its parts. In the context of our example, we can even show that an un-reflected combination of the optimization of local solutions would have destroyed the success of the whole firm. The local maximization of profit is the wrong explanation of overall economic success.*

Keywords: applied systems thinking; real-life business; business decisions; reductionism; bridging the gap between theory and practice; handling complexity; analysis of current credit crisis

1. Explication: Setting the Scene

Our investigations start with an explanatory analysis of an economically and otherwise fairly successful enterprise where the application of systemic thinking turns out to be the foundation of its success.

We have found that isolated solutions (resting upon local optimization) do not work. The real success in this enterprise rests upon a common understanding ("we are the problem solvers for the customers!"), strong individual commitment (buy-in from group members, trust, mutual respect) and the ability to make decision as a group (cf. especially the installed "[knowledge-] management team") on the one hand and an interdisciplinary constructive dialogue (based on sharing expertise) and local mutual correction supported by the structure of the firm on the other. In short, the sustainable economic success of the firm is built upon "thinking together and learning from each other" in a small and therefore survey-able unit that helps to prevent an excessive overuse of resources for local maximization of profit (as a wrong explanation of economic success). Taking up the research of Ostrom, one could see that the value creation in the described unit corresponds to the economic idea of "commons".

There is also some evidence that the optimal success of the whole (the firm) is definitely more than just the sum of the optimization of the success of its parts, i.e. the connection of local optimization (isolated solutions) in comparison to an optimal solution for the whole. Our example can even be used to demonstrate that further combination of locally optimized solutions would have destroyed the firm as a whole. What had been missing temporarily was mutual understanding and the corrective power of dialogue.

We therefore want to give reasons to apply the systemic approach in real-life business.

2. Norms and Life: The Limits of Reductionist Thinking

In order to understand and to explain the coming about and the application of faulty "measures" in economics, we investigate the "relation" between language, information/knowledge and reality (LIR) in its influence upon economic decisions (with respect to those measures taken by managers).

The basic idea is contained in figures 1 and 2, which can also explain the necessary limits of reductionist thinking.

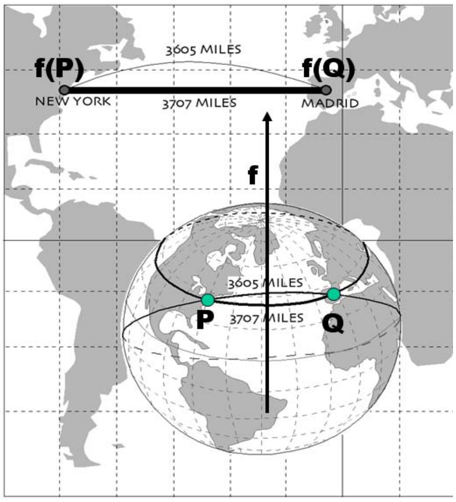

Figure 1: Geo example

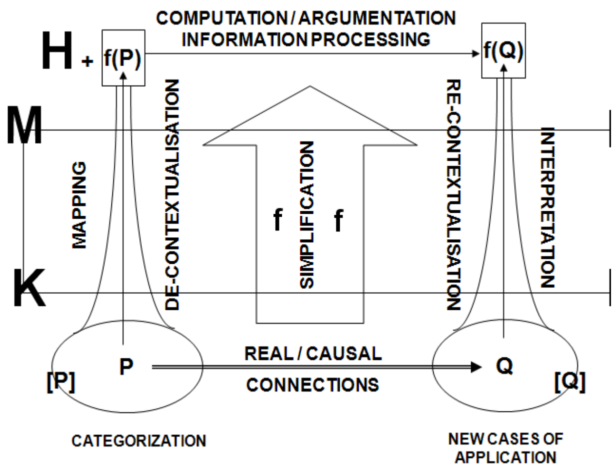

Figure 2: LIR – basic scheme

The main idea, why things go wrong (e.g. in the current credit crisis), is the missing distinction between causal connections within (segments of) reality and logical (or conditional) relations in language.

Usually, we consider the (analytical) explanations of e.g. economic success as "causal connections" between more or less well-prepared situations P in a real enterprise and the result of the application of some economic "measures" to produce "valuable" (successful) results Q. In "explanatory" arguments, however, we replace the causal connections by logical relations (in language). The latter are much too easily (mis-) understood as techniques of information processing, which can be projected and are assumed to correspond to causal time sequences of events (cf. Bruner: Acts of Meaning, 1992).

This "reductionist explanatory approach" usually works only within a limited area (or a middle realm) of experience and is in need both of understanding the simplifying assumptions (cf. the mapping f in figure 2) to create (at least in our minds!) classifications [P] or categories of quasi-equivalent, i.e. well "prepared" events, and also rests upon the local validity of a structure preserving mapping f from sections [P] or [Q] of reality onto some language. Usually, this is called a homomorphism and is expressed in the formula f (P => Q) "equals approximately" f (P) → f (Q), cf. figures 1 and 2.

In order to be able to "see" the "limits" of this kind of (classical) reductionist explanation, we strongly need systems thinking and the chance to correct the results of the coming about of our “computations” with the help of dialogue, practice and re-interpretation/re-identification of our calculations, i.e. an understanding of the projection of our theory onto segments of reality, based on background knowledge **H** consisting of the knowledge components **E** (expertise), **F** (folk knowledge), **K** (routines and rules) and **M** (explanatory meta-knowledge), cf. figure 2.

The relevant question is: “When is it (metaphorically speaking) essential to take into account the “curvature” of reality?”

3. Replacement: Re-Applying Theory (on-) to Practice

Our central aim was to bridge the gap between theory and practice or reductionist and systemic thinking. Thus, we did apply our explanatory analysis of the “success” of the firm to the solution of some problems, which recently turned up within that firm and which were connected to “island” solutions in warehouse keeping. Technically speaking, we combined our own systemic approach with ideas of Senge’s “Dance of Change” and “The Necessary Revolution” and finally the “Canvas Method” (Osterwalder & Pigneur, 2011) for “Business Model Generation”.

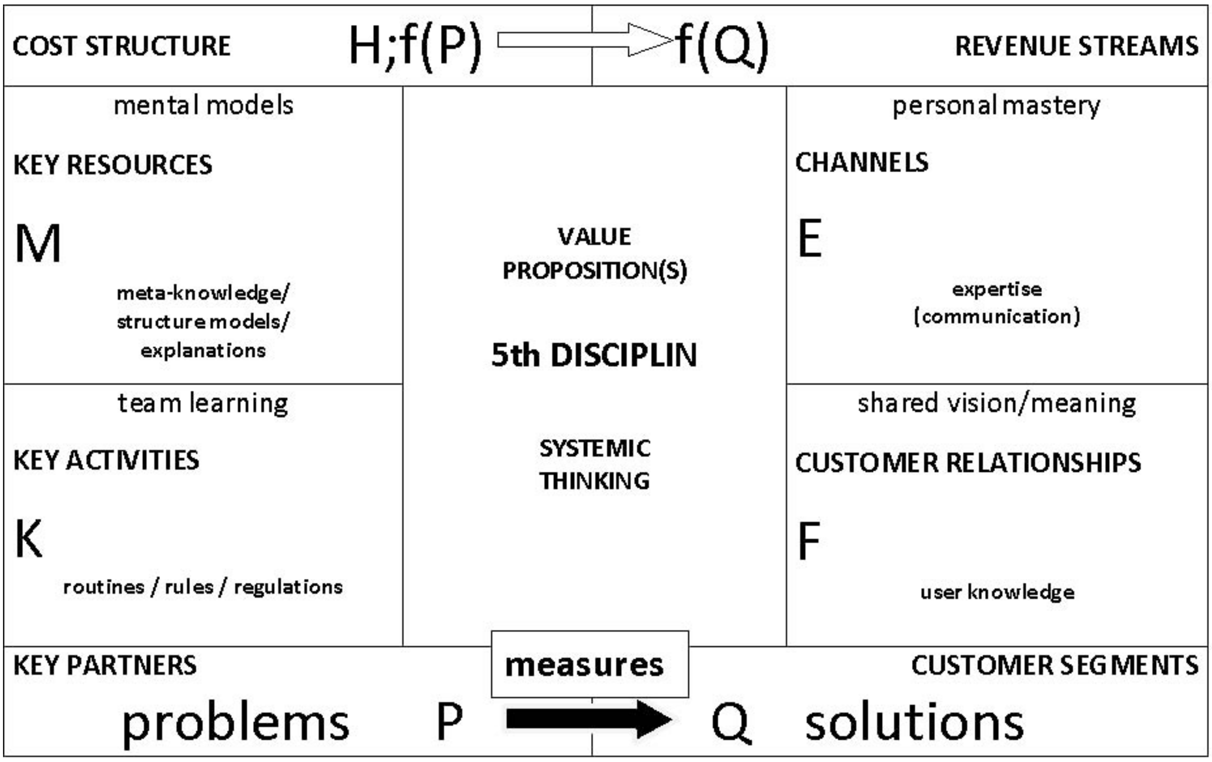

Figure 3: The business model Canvas (tilted) in combination with LIR & Senge’s 5th discipline approach

In this way, we achieved a **state of reflection** in the (knowledge-) management team of the firm, which could do justice both to isolated, locally optimized business solutions as well as taking care of corrective interaction on the meta-level. This led finally to an overall solution saving the firm from ruin by insolvency. We achieved an understanding of the limits of any reductionist “rule system” and of the limits of the “canvas method” if taken too literally. Producing the right or agreed upon parameter values is not enough! Additionally, one needs to establish a feeling of concernment or simply a combination of theoretical and emotional understanding. If we take up e.g. Meadows’ “Fish Banks Ltd. Game”, one can see that rationally we can understand a depicted situation but in practice still do the wrong thing. Only at Harley Davidson’s they were more successful. This has to do with their culture, *"which has long valued organizational learning, systems thinking, and conversation between and among groups as core business practices" (Senge, 2008, p. 171).*

What is also important is Damasio's brain research on emotions in connection with the economic research by Fehr and others (ultimo games). Only if there is a personal attachment/concern, one can emotionally accept action guiding/changing results, which do not correspond to main-stream economics. There is therefore another point inherent in our systemic approach: We have to identify those components of background knowledge **H** (cf. figure 2), which can "produce" the acceptance of an argument to the best inference. Systemic thinking in our context concerns the interplay, the dynamics and the two-way influence between the knowledge components that build up **H**. They must not be viewed as isolated elements! Instead, it is necessary to consider "today's dynamic organizational complexity", i.e. we have to understand the limits of linear and reductionist thinking.

Furthermore, it is necessary to change background knowledge to be able to "accept" certain inferences of explanatory argumentations. This "acceptance" cannot be reached by reductionist approaches alone. So, we need to be able to produce and introduce background knowledge in a new way, which generates emotional understanding (cf. Damasio) as a means of correction, helping to create "meaning" as a means to come to terms with reality.

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Cybercrime in the Bolivarian Republic of Venezuela: a Systemic Perspective

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Abstract: *This study evaluates cybercrime in the Bolivarian Republic of Venezuela from a systems perspective. The methodology for the study of human activity systems made Checkland was used in the investigation. The Special Law Against Cybercrime (LECDI) belonging to the Venezuelan legal system is identified as a human activity, expressed through the following definition, which contains the crucial features inherent in the definition. Designing a conceptual model and describes the activities and major subsystems of the system under consideration, consisting of a prevention and protection subsystem and a subsystem penalties. The system resources or means within the same permit the transformation process are identified. The system environment, comprising: actions carried out by individuals on their behalf or on behalf of legal persons, through the use of media using information technologies, and by the Venezuelan legal system or legal environment for the application of law, are analyzed in this study. The research also presents an analysis of the typical behaviors described in the Special Act against Cybercrime, discriminated on the basis of legally protected. The responsibility of individuals and corporations is analyzed in the research. The imprisonment, deprivation of other rights and pecuniary presented schematically. The law in addition to its application in all the events described therein committed within the territory of the Republic, can be applied to computer crimes committed outside the territory of Venezuela, where they affect a legally protected in Venezuela, protected by law. The Extraterritoriality is discussed briefly in the investigation.*

Keywords: cybercrime; computer criminal law; systemic thinking

1. Systemic study of the Cybercrime

The development of information technology and communications has been a positive impact on society. Along with these advances have appeared illegal actions carried out with the use of these technologies. It is in the presence of new types of crimes known to the law and doctrine as cybercrime. On October 30, 2001, was enacted in Venezuela, the Special Law against Cybercrime (LECDI) in order to establish a framework of legal protection for systems using information technology, prevention and punishment of crimes against such systems or crimes committed through the use of these technologies. The research aims to contribute to the assessment of this criminal law, pioneer in Venezuela, in this context is evaluated this legal instrument like a system. Morin (1985) believes that because the concept of system has to deal with three faces, system interactions and organization. The methodology of Checkland (1993,1994) for the study of systems of human activities, has been in constant use in research studies in different application domains worldwide.

2. Legally protected criminally protected by the Special Act against cybercrime

The Special Act against cybercrime (LECDI) describes a set of behaviors discriminated on the basis of legal right through the use of means using information technology, it is violated. This set of behaviors designed to protect systems using information technology and the prevention and punishment of crimes committed against the systems and using information technology, determines or sets a legally protected group. Among them are: security systems using information technology; the property; confidentiality and privacy of electronic communications; the interests of the child or adolescent; the intellectual property; rights and interests of consumers and users; safety compliance and e-commerce transactions; access to knowledge as a form of personality development; access and use of Internet as a priority policy of the Venezuelan state for cultural, economic, social and political development of the Republic.

2.1. Defining root system of human activities

The system of human activity: cybercrime in the Bolivarian Republic of Venezuela (RBV) contains the following elements CATWOE:

C: A natural person acting on his behalf or on behalf of legal person, with
punishable typical behavior that hurts the legally protected by LECDI criminal and/or
natural person or legal entity, owner, holder, holding the legally protected.

A: natural person who acts on behalf or on behalf of legal person, with punishable typical
behavior that hurts the legally protected by LECDI criminally.
natural person or legal entity, owner, holder, holding the legally protected.
Bodies of the Judiciary and the justice system set out in Article 253 of the CRBV

T: Protection of legal rights protected ⟶ legally rights protected
Typical behaviors punishable ⟶ conduct punished for violating legally protected

W: In total respect for the human dignity of victims of crimes and their perpetrators.

O: State Constitutional Law

E: Behavior of natural persons on their behalf or of legal persons, through the use of
through the use of means they use information technologies and communication
Venezuelan Legal System

A root system definition of human activities for the special act against Cybercrime (LECDI) is established as: *a system belonging to the State Constitutional Law under the Venezuelan legal restrictions, protect, prevent and punish conduct of natural persons acting on their behalf or on behalf of legal persons, that using information technology as a means or an end, injure or endanger, without just cause, the criminal legal rights protected. Typical behaviors are punished in full respect for human dignity of victims and perpetrators.*

2.2. Conceptual Model

Figure 1a shows the conceptual model which is: "a systemic description of a human activity system, built on the basis of the definition of the system root, usually in the form of a structured group of verbs in the imperative mood. This model must contain the minimum activities necessary for the system that matches the definition named in the root" (Checkland, 1993, p. 353). Figure 1b shows subsystems identified in the system under study.

3. Conclusions

This research describes the special act against Cybercrime (LECDI) of the Bolivarian Republic of Venezuela as a human activity system represented by a conceptual model derived from a root definition. The act as a system is open immersed in an environment with which it interacts and contains a set of activities in which they identify components or subsystems and resources. This work confirms that the conceptual and methodological proposals of systems thinking can be considered in the treatment of situations of the science of law.

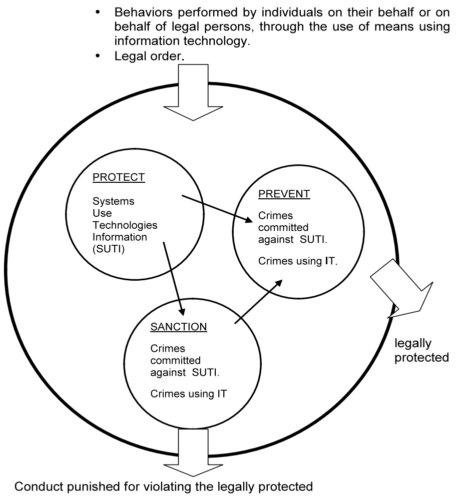

Figure 1a: conceptual model of LECDI

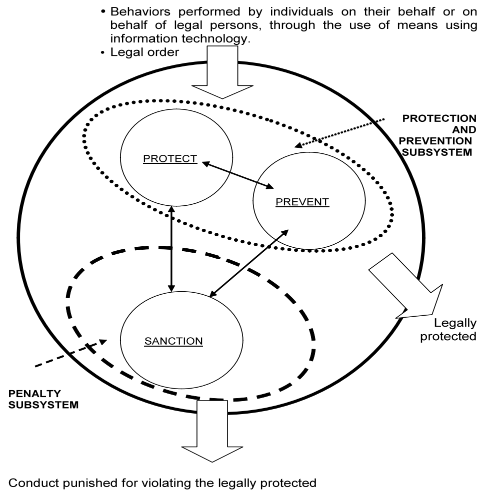

Figure 1b: Subsystems of LECDI

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Establishing a Systemic Foundation: the Required Structure on which to Implement a Systems Approach to Managing Dynamic Complexity

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Abstract: *The vast majority of organizations today are designed along a hierarchical structure in which activities are grouped together along common areas of responsibility. Processes are defined and controlled within strict functional boundaries, with minimum attention given to systemic interaction. Information relative to performance is generated functionally and processed locally as defined in standardized procedures, consistent with the requirements of mandated policies. Business decisions are derived through analytical methods in the context of a reductionist approach: reducing the whole into its constituent elements, understanding each element separately and aggregating understanding of the elements into an understanding of the whole. Given the dynamic complexity of the organization's business environment, application of the reductionist method typically results in the loss of the essential properties of both the system managed as well as its constituent elements (parts). Hence, business decisions lack cohesion, and management, the ability to consistently align activities to effectively achieve the organization's long-term objectives. This work will address the manner in which the modern organization or business can build a systemic foundation which is a prerequisite to the practical integration of a systems approach into the organization's management paradigm.*

Keywords: building a systemic foundation; systems thinking; systemic approach; DIKUW Hierarchy; managing dynamic complexity

1. The Systems Approach

Systems thinking is the process of understanding how various elements affect one another within a defined unified whole. A systems approach focuses on the understanding of the interactions of the constituent elements of a system that produce a behavior rather that the segregated parts of the system, studied in isolation. In order to deliver long term results in the most effective and efficient manner possible, the organization must understand its key operational, enabling *(support)* and management processes, and how these processes fit together. This typically means developing a capability to manage issues across teams and functions, with people throughout the organization having an understanding of the end-to-end process, not just their part of it.

A systems approach allows the organization to successfully apply systemic methodologies and/or multimethodologies together with traditional management tools for the purpose of achieving a level of effective operation through fact-based decision making, which in turn gives the organization awareness of the long term consequences of its actions *(actions taken or avoided).* The need for a systemic approach has never been more imperative, given the realities of the new economic climate impelled by the current credit crisis and the need for organizations to challenge existing paradigms, core values and business assumptions against the dynamic complexity of a volatile economic environment.

2. Building a Systemic Foundation

This work addresses the manner in which the modern organization or business can build a systemic foundation which is a prerequisite to the practical integration of a systems approach into the organization's management paradigm. The organization's systemic foundation is build by identifying the interrelated and interdependent elements interacting as a structured functional whole *(system)*; determining the flows between these elements and their systemic relationships, recognizing recurring patterns of the system's behavior over time; aligning the organization's strategic priorities and tactical planning to the system's operational capabilities, through formal methods, dynamic tools and structured initiatives; and finally, developing and implementing a monitoring and measurement system which provides feedback relative to the system's performance. The organization's systemic foundation serves as the platform which bridges the gap between perception *(desired state)* and reality *(actual state)* and the means through which to apply systems thinking methodologies and/or multimethodologies to the organization's Data, Information, Knowledge, Understanding, and Wisdom Hierarchy.

3. Systems Approach and the Organization's Management Paradigm

Data is generated in the organization, proactively or reactively, as a result of its daily operation. Raw data lacks substantial meaning and simply represents objects, events, or other properties. Data needs be coherently processed *(identifying cogent relationships)* so as to present meaningful information. Information provides answers to questions which begin with “who”, “when”, “where”, “how many”, etc. The manner in which data is structured, processed, articulated and perceived is critical to the value of the information it conveys. Methodical treatment of the content of information *(so as to create useful meaning)* creates knowledge. Knowledge addresses “how-to” questions. Knowledge in this context is implied as “know-how”, rather than awareness. Know-how is contained in instructions, which are developed and disseminated in the organization in the form of documented process-oriented operating procedures for the purpose of process control and continuity. Synthetic treatment of accumulated knowledge through the use of systemic methodologies and/or multimethodologies provides understanding. Understanding in this context, refers to the practitioner's ability to answer the “why” questions which requires a clear perception of dynamic system interactions. Through understanding, existing knowledge is expanded to address conditions *(systemic relationships)* which are neither controlled nor routine. The last level in the hierarchy is wisdom. Wisdom encompasses and gives meaning to all of the four elements previously stated. It is awareness of the long-term consequences of actions taken *(or avoided),* supplies the necessary motivation to challenge traditional paradigms, and provides a sound approach with which to address unforeseen change. Wisdom is in the core of the organization's capability to make choices that sacrifice short-term goals for the purpose of realizing long term objectives. Wisdom is reflected in the organization's ethical posture and corporate position relative to its environmental performance and social responsibility. Wisdom is the essence of systems thinking and the result of adapting and integrating a systemic approach into every-day business operations.

Adapting a systems approach and applying systemic methodologies and/or multimethodologies enables management to embrace a factual approach to decisions making. The organization's processes, assets, culture and politics, employee required and emergent systems, existing and potential customers' needs, suppliers' capacities, competitors' capabilities, and governmental agencies' requirements are all essential elements of a unified system. The product of the interaction of these interdependent elements needs to be approached and understood as a unified whole. Understanding the fundamental systemic relationships, which affect the behavior of the system over time augments the organization's capacity to manage the system's complexity.

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Adaptive Human-System Interface for Control of Complex Systems (in Application to Nuclear Power Plant)

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Abstract: *The paper describes categorization of human-system interfaces recently used at nuclear power plants. Conventional, ecological, task-based, function-oriented and immersive interface are considered. The relevance of the each type of interface under different operational modes have been evaluated as a result from analysis of the activity to be performed by the operator under normal or abnormal conditions. This provides a conceptual framework of adaptive human-system interface for control of complex industrial systems.*

Keywords: human-system interface; nuclear power plant; complexity; operator; adaptive interface

Large-scale industrial objects, such as Nuclear Power Plants (NPP), are extremely complex systems consisted of a great number of interacting equipment, automatics and humans. The main contributors to system complexity are: interaction between components, transformation of matter and energy, Human-System Interface (HSI), and the competence of operators. NPP operator activity is based on the three main kinds of information, namely: *process information* reflecting current state of the plant, *alarms* attracting operators' attention to the significant process events, and operational *procedures* guiding operators. During last two decades HSI was evolving from conventional dashboards to computerized facilities. A few innovative approaches to HSI design, such as ecological, task-based, function-oriented interface, has appeared during last 15 years. However the computerized interface creates new problems, such as the key-hole effect, complicated navigation, secondary activity.

The main idea of this paper is to carry out a system analysis, which enables to formulate a philosophy of application of different HSI types through the understanding of the main tasks to be performed by HSI under various NPP operational modes.

1. Types of human-system interface used at NPP

Variety of the interfaces used at NPP can be grouped into five categories.

Conventional Interface represents information by means of instruments, such as scale indicator, trend recorder, etc., and control actions are executed using switches and buttons.

Diagram-Based Interface represents the numerical information mapped on a mimic diagram.

Ecological Interface (EI) (Vicente & Rasmussen, 1992) represents the process parameters in a special manner which facilitates interpretation of process data and supports cognitive activity (such as comparison or summation) to be performed by operator when estimating the situation.

Function-Oriented Interface (FOI) (Pirus, 2004) represents the plant as a set of interacting functions instead of traditional representation as a set of pumps, tanks, valves, and pipelines.

Immersive Interface (II) or virtual reality describe not only the process information but also the structural information. The simplest example is a three dimensional image of the plant.

There are three different strategies used for selection of the information to be represented to operator within one display format. The most popular strategy is to dedicate each display format (*System-Oriented Display*, SOD) to a certain technological system or equipment, e.g. condensate system or steam generator. Another strategy consists in integration of the key information into *Overview Displays* (OD) which supports operator in assessment of the situation at the plant as a whole. The third strategy consists in integration into a *Task-Based Display* (TBD) of the process information and the procedural information which is relevant to the current situation.

2. The concept of adaptive interface

Rothrock et al. (2002) proposed four the features of interface to be modified depending on the context, namely: the content, the dialog, the task allocation in terms of level of automation, and the speed of adaptation. The following factors are usually considered as triggering adaptation: the current situation, the task, and the user.

2.1. Adaptation of content

The content adaptation driven by the current situation and by the user task seems to be the most valuable ability of HSI. During normal operation (Figure 1) the plant remains in a steady state. The main task of operator is to monitor the plant and to identify any minor local violations and deviations from the steady state. The plant functions overview display providing configuration of the plant equipment is suitable for that purpose.

In case of omission or failure to compensate local violation, the process parameters achieve the setting of alarm activation. The task of HSI is to integrate information on the activated alarm, the appropriate response procedure and the affected system into a task-based display. In order to prevent extension of disturbance, operator has to anticipate possible threats and paths for expansion of violation. HSI could support this activity by representation of the functions which are under threat. The ecological interface supports to estimate whether the parameters are in balance.

When the process parameters exceed the operational limits, operator has to identify the event initiating t current situation and to follow the appropriate event-based procedure. The task of HSI is to select from numerous alarms the alarm that describes the initial event. This alarm together with the relevant procedure and the process data could be integrated into a task-based display. In case of transient and considerable change of the process parameters, an ecological interface supports operator in the monitoring of process dynamic and of balance between the key parameters.

In case of serious deviation of the process parameters, the emergency protection is activated. Subsequent reactor shutdown and fast deep transient require operators to move their focus towards nuclear safety, especially when the safety systems setting or the safety limits have been exceeded. HSI has to indicate the initial cause of protection activation and to prioritize the alarms in accordance with importance for safety. Also, the task of HSI is to indicate status of so called ‘critical safety functions’. The function-oriented interface is suitable for performing the both tasks.

Any severe transient requires operators to monitor dynamics of the plant as a whole. Therefore, the mission of the ecological interface is to provide operator with the plant energy and mass balance overview. It is especially helpful when operator faces with unknown situation. In this case operator has to implement the appropriate symptom-based procedure which should be identified and represented by HSI. Another information which is relevant under accidental conditions is a 3D-view of the plant construction. This is very important for investigation of possible damages, paths of expansion or ways to repair damaged equipment.

2.2. Adaptation of task allocation

The great part of their duty time operators are idle. Long periods of idleness may result in monotonia and loss of control of the plant. In order to keep situational awareness, HSI should delegate part of monitoring and/or control functions from automatics to human. Vice versa, operators' attention is narrowed and the speed of response is retarded under stress conditions produced by severe fast transients. Therefore, the most important and urgent actions have to be done by automatics. However, automatics is not effective when unknown event or severe accident occurs. As a rule, such situation requires joint human and automatics efforts.

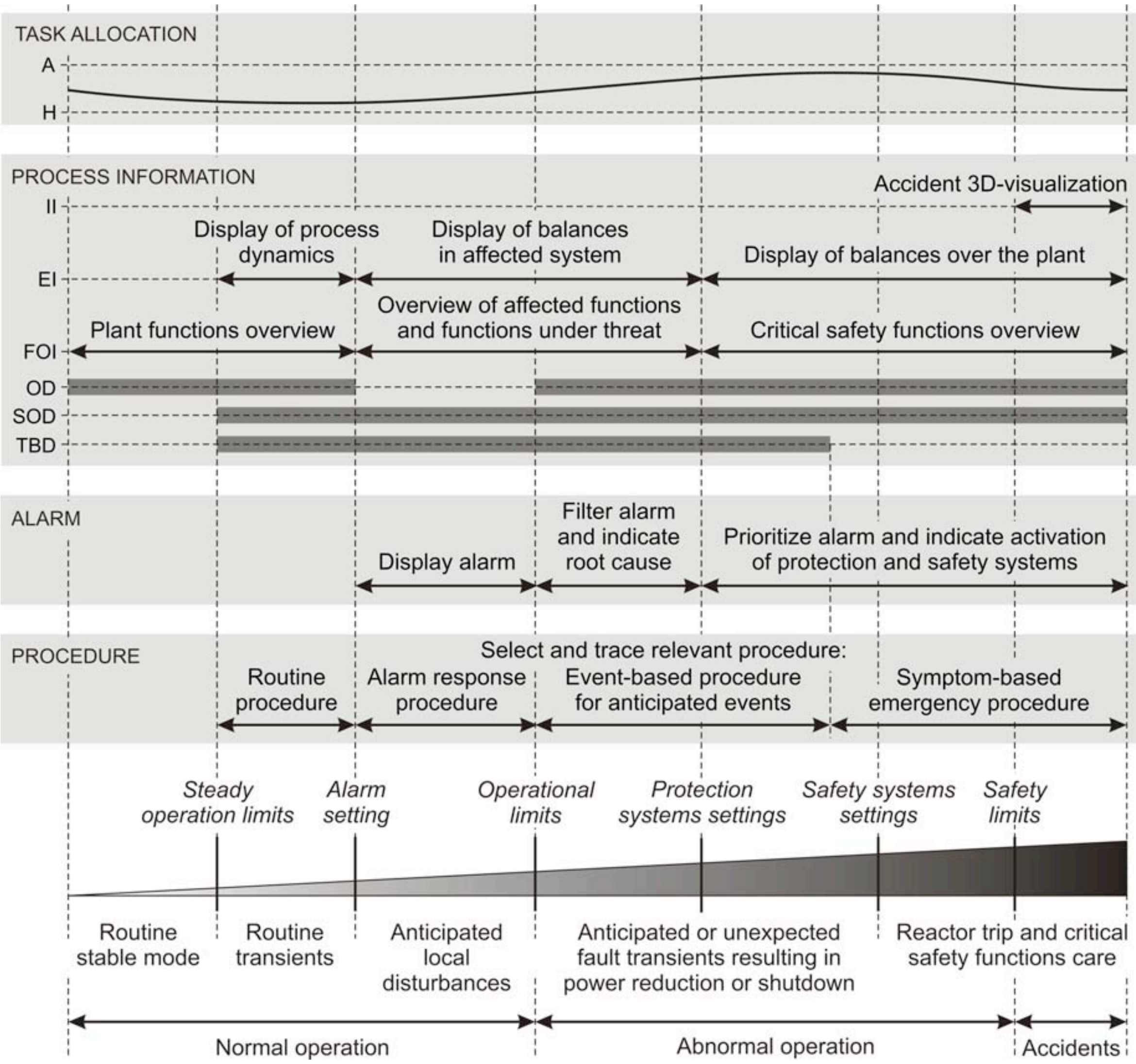

Figure 1: The main tasks for various types of HSI in the light of NPP operational modes

The paper will include the extensive survey of publications concerning various types of HSI and the detailed explanation of the logic triggering adaptation of HSI.

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Internet Access as a Fundamental Right and Progressive Expression of Human Rights in Venezuela: Systemic View

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Abstract: *The Venezuelan State guarantees to every natural or legal person, without discrimination, respect, enjoyment and inalienable exercise, indivisible and interdependent of its human rights. The Constitution of the Bolivarian Republic of Venezuela (2000) recognizes the principle of progressivity in human rights protection. The treaties, pacts and conventions signed and ratified, prevail on the positive system as containing rules on the enjoyment and exercise of human rights more favorable. Official data from the third quarter of 2011 provide that 37.91% of Venezuelans have access to internet. The mobile index is 92.65% (26,985,633 mobile lines/subscribers). The inflation in 2011 was 27.6%, triple the average for countries in Latin America. The employment rate is 91.4%. NGOs such as the Observatory of Labor Affairs estimated that in January 2011, 46% of the economically active population (5.9 million people) work in the informal sector of the economy and 1.6 million of those informal workers have an average monthly income of 523 U.S. $ (official exchange rate). The formal minimum wage in Venezuela is 360 USD. The National Statistics Institute (INE) estimated for the first half of 2011 that 32.9% of the Venezuelan population is poor, divided in 8.8% and 24.1% in extreme poverty and non extreme poverty, respectively. Presidential Decree No. 825 (May 10, 2000) established the access and use of Internet as a policy priority for the cultural, economic, social and political development of the Republic. The United Nations Organization (June 2011) declared Internet access a human right to be a tool that promotes growth and progress of society, recognizing the potential this represents for a more advanced and egalitarian society. The UN consider internet a fundamental right and calls on governments to facilitate its access to all their citizens. The development of public policy for massive acquisition of equipments, connection quality, integration into the formal education system, among others, determine the increase in Internet access and productive use, enhancing educational opportunities with social impact on society . The research method employed was the soft systems methodology (SSM).*

Keywords: human rights; Internet; systemic thinking

1. Systemic Thinking and Soft Systems Methodology (MSS)

This paper uses systemic thinking approaches in dealing with internet access as a fundamental right in the Bolivarian Republic of Venezuela (RBV) and expression of progressivity in human rights. Checkland P. (1993, 1994) designed a methodology for addressing human activity systems, which consists of seven phases. Phases 1 and 2 of the methodology in this study and correspond to the inequalities present in Venezuelan society. Phases 3 and 4 is the design of a system of human activity. In these phases should be displayed human activity system - conceptual model that is implied by the following definition considered. The root definition says that "it is" human activity system under study, while the conceptual model says "what is" the system. Checkland (1993) states that the root definition corresponds to: "a concise and built with precision of a human activity system which states what the system is." The root definition must contain the six factors grouped under the mnemonic CATWOE representing the crucial features that must contain a root definition.

2. Internet access as a fundamental right

The United Nations (June 9, 2011) declared Internet access a human right because: "More than a possibility of communication is becoming a necessity due to the period of globalization which we live today (...) the changing nature of the Internet not only allows individuals to exercise their right of opinion and expression, but also part of their human rights and promotes the advancement of society as a whole, The UN Special Narrator, Frank La Rue said: "must do" for the Internet is "widely available, accessible and affordable for all" and ensure that access to the internet, "must be a priority for all states" .

3. Root definition of relevant systems

The system of human activities: provision of quality Internet access as a fundamental right in the Bolivarian Republic of Venezuela (RBV) as an expression of progressive Human Rights contains the following elements CATWOE:

C: Venezuelan citizens and foreigners residing in the RBV
A: Civil society mobilized and active Venezuelan state generating public policies that strengthen rights socially responsible companies with the development of the nation
T: Venezuelan citizens and foreigners residing in Venezuela excluded from access to internet
Venezuelan citizens and foreigners living in Venezuela with quality services
internet access Educational opportunities with social impact on society
W: "Venezuela is a democratic and social state of law and justice, which holds as superior values of its legal system and its performance, life, freedom, justice, equality, solidarity, democracy, social responsibility and general, the preeminence of human rights, ethics and political pluralism". Article 2 CRBV
O: Constitutional Law State characterized by the Venezuelan state and society civil
E: Universal Declaration of Human Rights and Venezuelan legal
Inequities and social determinants of Venezuelan society

The following definition is set as: *a system belonging to the state constitutional law recognizes and enforces the Universal Declaration of Human Rights in the Venezuelan legal system with social determinants and inequities in society, which allows citizens residing in the republic, the right to quality services in the internet access to assist with the construction of a democratic and social state of law and justice, which holds as superior values of its legal system and its performance, life, freedom, justice, equality, solidarity, democracy, social responsibility and, in general, the preeminence of human rights, ethics and political pluralism*.

4. System environment of human activities

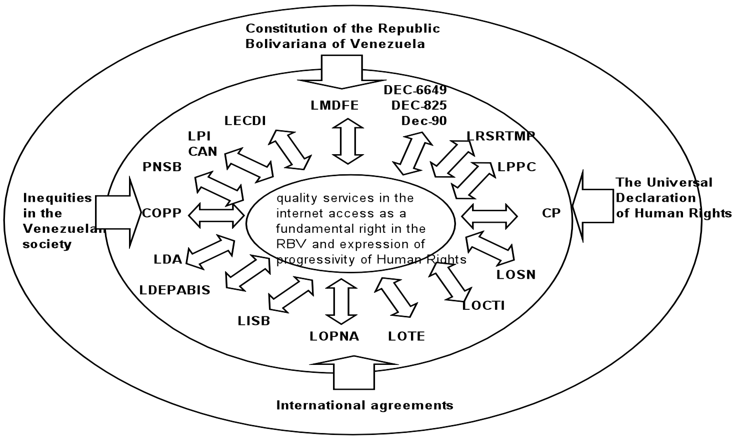

Figure 1: Environment of the system of human activities

5. Conclusions

This research applies the soft systems methodology to a problem situation expressed through a system of human activity: quality services in the internet access as a fundamental right in the Bolivarian Republic of Venezuela and expressions of the progressivity of Human Rights. It is necessary to rescue the spirit and effectiveness of public policies coupled with the participation of civil society and social enterprise committed to deepen the overcrowding, acquisition of equipment, connection quality, integration into the formal education system, generation of content, among other plans, programs and strategies to facilitate increased access to quality Internet to enhance educational opportunities with deep social impact on Venezuelan society.

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Deployment of the Design & Control Systemic Methodology (DCSYM) for the Management of the Registry of Patients with Primary Immunodeficiencies (PID) in Greece

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Abstract: *The paper demonstrates the deployment of the Design and Control Systemic Methodology (DCSYM) in the Management of the Registry of Patients with Primary Immunodeficiencies in Greece. DCSYM is a systemic methodology with a robust mathematical and semantic understructure capable of effectively guiding multi-agent dialectic design processes concerning boundary critiques, structures, procedures and interventions. Primary Immunodeficiency Diseases (PID) comprise a genetically heterogeneous group of disorders that affect distinct components of the innate and adaptive immune system. The DCSYM was deployed in the Department of Immunology-Histocompatibility of the "Aghia Sophia" Children's Hospital in Athens, Greece, which serves as a Specific Center & Referral Center for Primary Immunodeficiencies – Paediatric Immunology.*

Keywords: Design and Control Systemic Methodology (DCSYM); Primary Immunodeficiencies (PID); registry management

1. Primary Immunodeficiencies (PID) / Registry of Patients

Primary Immunodeficiency Diseases (PID) comprise a genetically heterogeneous group of disorders that affect distinct components of the innate and adaptive immune system. They are classified as rare diseases, but appear more often than we think and can appear during childhood, adolescence, or adulthood. More than 200 inherited conditions have been identified within this group of diseases, mostly monogenic, predisposing individuals to infections, allergic or autoimmune manifestations and lymphohyperproliferation.

The International Union of Immunological Societies has classified PID in eight categories: 1. combined T-cell and B-cell immunodeficiencies, 2. predominantly antibody deficiencies, 3. other well-defined immunodeficiency syndromes, 4. diseases of immune dysregulation, 5. congenital defects of phagocyte number, function, or both, 6. defects in innate immunity, 7. autoinflammatory disorders, and 8. complement deficiencies.

The need for the Registry of PID-patients originated from the rarity of these diseases, the lack of knowledge for their existence and their biomedical importance in relation to other diseases, the development of new therapeutic approaches and finally, the acute impact on the lives of patients, their families and the community.

The Department of Immunology-Histocompatibility of “Aghia Sophia” Children’s Hospital, being the only Paediatric Immunology Department in Greece, as a Specific Center & Referral Center for Primary Immunodeficiencies – Paediatric Immunology (http://www.paed-anosia.gr), developed a communication network comprised of doctors and scientists throughout Greece disseminating information resulting from data collected from patients with Primary Immunodeficiencies in the country. In addition to medical professionals, the aim of the program is to promote awareness of PID to other Health Care Professionals employed in the Health Care Sector.

The research has the endorsement of the 1st Health Region of Attica Prefecture.

2. Deployment of the Design & Control Systemic Methodology (DCSYM) for the Management of the Registry of PID Patients in Greece

DCSYM is a systemic methodology with a robust mathematical and semantic understructure capable of effectively guiding multi-agent dialectic design processes concerning boundary critiques, structures, procedures and interventions. The central concept in the application of DCSYM is the identification of the essence of structural and other problems with the use of a systemic methodology.

The DCSYM was deployed in this case in order to understand the core structures of the system (the Department of Immunology-Histocompatibility of “Aghia Sophia” Children’s Hospital), its external environment (the main hospital, other hospitals, paediatricians, partners, collaborating organizations and societies and others), the communication layers between the various elements of the system and finally, the existing controls. Figure 1 illustrates the underlying structure and relationships between the various elements of the system.

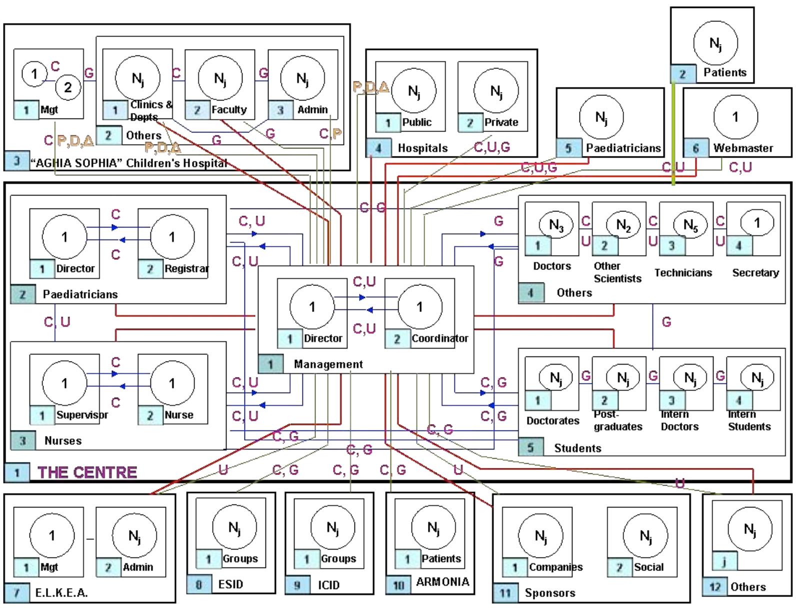

Figure 1: Deployment of the DCSYM in the Department of Immunology-Histocompatibility of “Aghia Sophia” Children’s Hospital

The methodology was instrumental in augmenting understanding of the systemic interaction of the system’s elements and the underlying structures associated with the Center’s internal and external operating environment. Finally, the methodology illustrated the communication arrangements, which contribute to delays in system flows that impact the operating effectiveness of the procedures associated with PIP registration processes.

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Symposium J. How to Integrate Language, Meaning and Mind with Cybernetic-Systemic Theories of Information?

Chair: Søren Brier

The current state of Information Science is very complex, as there are incompatible paradigms that have not made their implicit ontologies and epistemologies clear. This holds for cybernetic-systemic approaches too.

E.g., Wolfgang Hofkirchner's Unified Theory of Information (UTI), based on Ludwig von Bertalanffy's General System Theory in combination with a theory of self-organization and emergence going from nature into social system theory, is not really compatible with Claude Shannon and Norbert Wiener or even Gregory Bateson's further development of Wiener's concept of information.

Other researchers and practitioners work with pan-computational and informational paradigms, where they develop concepts of natural computation that go beyond the Turing definition of algorithmic computing. Such a pan-informational and pan-computational view is for instance promoted by Gordana Dodig-Crnkovic (ICON).

But all of these paradigms lack the first person phenomenological approach of human experiential consciousness as the basis for meaning production in the subject as well as intersubjective sign production.

Then there is second order cybernetics and autopoietic theories based on an observer making meaningful distinctions. The problem is that Spencer-Brown, certain interpretations of Bateson and Maturana and Luhmann's combination of these in a triple autopoietic system theory of communication all presume a conscious observer, but do not really encompass the latter in their ontological foundations.

Differing from this is Søren Brier's attempt to integrate Peircean pragmaticistic triadic and phaneroscopic semiotics with the Luhmannian approach in what he calls a Cybersemiotics. Cybersemiotics is an attempt to put Luhmann's theory inside the Peircean epistemological and ontological framework and cure the illness of both paradigms as well as the general problems of the previous attempt to make a unified theory of information.

This track is open for contributions to clear up, solve these problems of how to produce a transdisciplinary theory of information, cognition and communication or elaborate already suggested solutions.

Christina Weiss: *Phenomenology, Constructivism and Cognitive Science - Foundational Aspects of a Unified Theory of Cognition*

Søren Brier: *How is Transdisciplinarity Possible in the Area of Cognition, Communication and Meaning Across Nature and Culture? The Cybersemiotic Framework*

Jerry LeRoy Chandler: *Third Order Cybernetics: Logical, Mathematical, and Biosemiotic Principles*

Boris Sunik: *Representation of Meaning in the Theory of Meaningful Information*

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Phenomenology, Constructivism and Cognitive Science

Foundational Aspects of a Unified Theory of Cognition

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Abstract: *The so called cognitive sciences are still struggling with the theoretical integration of descriptions of cognitive processes based on scientific observations, models and theories on the one side and cognition as a form of construction or constitution of meaning, meaningful concepts, a meaningful world on the other side.*

Although phenomenology as a study of the constitution of meaning has gained some attention in dealing with the problem mentioned above during the last years, the sciences of cognition are far away from formulating an integrative framework for both sides of the coin: cognition seen from the process-related side of natural sciences and cognition seen from the conceptual side of philosophy, especially in the phenomenological version.

The reason for this is that neither natural scientists nor phenomenologist have described the problem under question as an essentially meta-theoretical problem with the essential methodological issues and the necessary precision.

If phenomenology is regarded as a methodologically reflected description of the constitution of meaning and system theoretic or related models of cognition are regarded as theories of the structure and functioning of processes related to meaning construction than one has to find a form of description that is in principle capable of representing both, the process-related and the conceptual side of cognition.

In this paper I will present one possible explication of the meta-theoretical problem such an integration of phenomenological and system theoretical descriptions is confronted with. I will also make a suggestion towards a possible way of dealing with this meta-theoretical problem.

I will pursue this intention by showing that in between phenomenology understood as a general theory of appearances and conventional scientific theories of the functioning of cognitive systems there exists a medium, a third form of description, which is able to relate the two other descriptions on a higher level of abstraction. As such an integrating medium I conceptualize constructive logics and mathematics.

Keywords: constructive logics and mathematics; calculus of distinctions; meta-theory of descriptions; information theory; phenomenology; unified theory of cognition; topology

As for example Shaun Gallagher and Dan Zahavi put it, "[phenomenology] attempts to capture the invariant structures of experience" (Gallagher & Zahavi, 2008, p. 26).

Examples of such 'invariant structures' are the 'intentionality of consciousness' – consciousness is always consciousness of something, the 'time-horizon of perception' – perceiving an object generally proceeds in the mode of actual/potential, of already drawn distinctions and possible future distinctions, which form a kind of a potentiality-horizon by which actual determinations are shaped, or the 'predicative', in case of intentionality 'pre-predicative mode of perception' (Husserl, 1993).

According to Husserl these and other invariants are constitutional for every experience that constitutes an object that is object- or world-related (ibid.).

Husserl claims to offer a theory of the invariant structures of object-relatedness in general. These invariants are the 'conditions, sine qua non', the necessary forms implicit in every object-constitution (Husserl, 1995).

Although Husserl holds that these invariants are transcendental, their formulation, their explication inside the phenomenological method relies on certain background assumptions, which do shape the form of phenomenology, the form of phenomenological descriptions (Weiss, 2006).

Take for example the central concept of intentionality: It is a core goal of phenomenology to ground logical judgements, which represent truth-apt relations of the experiencing subject to the world, in a general, pre-logical form of object-relatedness Husserl calls intentionality. But if one carefully investigates, how phenomenology describes intentionality one can see that it is formulated ‘through predicative eyes’, in the form of a predicative judgement.

So one could argue that phenomenology, at least in the Husserlian version, is an attempt to demonstrate that consciousness itself, lived experience itself does intrinsically, in its object-relatedness have the form or at least a pre-form of the predicative judgement.

Phenomenology in the Husserlian shape is a theory of conscious meaning construction understood as a genealogy of the predicative judgements out of lived experience. The question of the relationship between the postulated predicative concepts on the one side and the procedural side of cognition, the so called ‘acts’ is not being regarded sufficiently, there don’t exist any satisfying conceptual reflections about a theoretical explanation of this relationship.

On the other side there is the branch of mostly empirically oriented cognitive science with its different theories and models. Under these theories system-theoretic models of cognitive processes have gained more and more approval in the last years, realizing that the processes observed, e.g. neuronal activities, are highly connected.

Independent from the singular shape and interest of system-theoretic theories of cognitive processes, they are still struggling with the theoretical integration of “meaning” into their descriptions of cognitive systems. “Meaning” is mostly and in different ‘fashions’ added to the theories by showing correlations of procedural structures and meaning construction, but the formulation of the cognitive processes, elements, dynamics, structures isn’t itself shaped by the reflection that cognitive processes are meaning-related processes.

So both branches of description, phenomenology on the one side and systems theory on the other side are in deficit: the one of the procedural side, the other of the semantical side.

What is at stake is therefore a form of description that is in principle capable of both sides, that because of its form intrinsically has ‘space’ for both sides.

I want to suggest that logical and mathematical constructivism in the tradition of Brouwer, Heyting and Lorenzen and also in the different shape of a logic of distinctions as elaborated by George Spencer-Brown can take over such a role, at least on a meta-theoretical level of the general form of such an integration (Brouwer 1992, 1928; Lorenzen 1978; Spencer-Brown, 1969).

The reason for this is that the above theories transform the purely semantical concept of intentionality as phenomenology’s core concept into the more general, more comparable, formalizable concept of schematic construction (Weiss, 2006).

I will show that with an elaborated theory of schematic construction one is in principle able to formulate cognition on a procedural-semantic basis.

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Christina Weiss, born in 1973, philosopher, working on interdisciplinarian issues inbetween, phenomenology, systems theory, logics and mathematics and cognitive science. My central goal and core of research is the explication of a ‘unified’ theory of cognition that integrates the conceptual and the processual side of cognition.

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How is Transdisciplinarity Possible in the Area of Cognition, Communication and Meaning Across Nature and Culture? The Cybersemiotic Framework

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Abstract: *When we want to make an evolutionary approach to the area of meaningful cognition, communication, and culture, human communication and meaning in one framework have been reduced to only being recognized as individual cognitive representations, in others reduced to neural brain processes in individual brains (neuron-computational models of cognitive science), in others to be only collective, socially distributed phenomena (e.g. social systems theory), in still others to simple, objective 'information' processing (computational information science) and in some only signs (Peircean semiotics). If we are combine the knowledge of these different paradigms in a fruitful way and not on one hand only chose to reduce the problem to one of the paradigmatic solutions (in the sense of neglecting a coherent application of relevant compatible theories) or on the other choosing eclecticism (understood in the negative sense as the incoherent application of many incompatible theories), we need to work towards an integrated transdisciplinary, semiotic philosophy of science encompassing information science. This means to establish a meta-level from where to evaluate the applicability and adequacy of the different specific approaches and theories involved. This means to avoid natural, informational as well as social scientific reductionisms and to build theories that takes departure in the phenomenological life world of the human being and find a way to unite such a view with the truth seeking of the mentioned sciences as well as the meaning interpretation of hermeneutics and Peircean semiotics. Thus, we are forced to take departure in the individual embodied world of cognition build on signs coming from a real world. But we want to enlarge the idea of reality by combining the physical, the biological, the social and the subjective life worlds in one naturalizing move. Reality cannot be reduced to the physical as we know it today, because then it has to be enlarged with awareness and sense experience. Because we cannot deny that they are the prerequisite for having and producing knowledge as such. Language and its signs as well as all other signs are also real, as they are a prerequisite for producing intersubjective knowledge or Popper's World 3 of objective fallible knowledge. As Luhmann argue then communication is the essence of the social and Gadamer underlines that human's are interpreting beings placed in a historical cultural horizon of which science and it s result is a part. There is no meaning without a body, the cognition of signs as well as the connection of language and a culture in a culture-mental universe of meaning. Information science seems unable to grasp the foundational complexity of this statement.*

Keywords: cybersemiotics; semiotics; cybernetics; system theory; Luhmann; Peirce; transdisciplinarity; meta level frameworks; Gadamer; Popper; embodiment

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Søren Brier is a professor in the Semiotics of Information, Cognition and Communication Sciences in the Department of International Culture and Communication Studies at Copenhagen Business School. He is the founder and editor of the interdisciplinary quarterly journal *Cybernetics & Human Knowing* from 1992-, fellow of *the American Society for Cybernetics* and has been awarded *The Warren McCulloch Award*. He is member of the board of *Int. Ass. for Biosemiotic Studies* and its journal *Biosemiotics* as well as the scientific board of *The Science of Information Institute, Foundation of Information Science* and its journal *TripleC*. He is a transdisciplinarian integrating ethology, Peircean biosemiotics, second order cybernetics, Luhmanian systems theory, and embodied cognitive semantics into a frame for distributed cognition, communication and meaning he calls Cybersemiotics. He is the author of *Cybersemiotics: Why Information is not Enough* (Toronto University Press, 2008). He has published five books in Danish and numerous English articles and book chapters.

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Third Order Cybernetics: Logical, Mathematical, and Biosemiotic Principles

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Abstract: *In 1995, the existence of third-order cybernetics was inferred from the differences between the symbolic codes (genetic and mathematical) used to describe regulatory relationships in living and mechanical systems (see Chandler, 2008, 2009). During the intervening 17 years, the logical, mathematical, grammatical, and biosemiotic basis of feed back and feed forward relations of living systems was synthesized from physical, chemical and biological principles. From time to time, reports updated the scientific grounds for encoding biosemiotic messages appeared. This report is a further step in the development of a coherent scientific theory of third order cybernetics. Both the conceptual and pragmatic components of differential forms of steering systems are now grounded in the distinction between electro-mechanical and electro-chemical systems. Yet, the supporting biosemiotic structures (iconic, logical, mathematical, and grammatical) of both systems of cybernetics are intimately interrelated by common scientific principles. These exact mathematic principles are termed the Rosetta relations.*

Both feed back and feed forward processes contribute to the functional steerage of living systems. The multi-sets of feed forward processes that are entailed by biological inheritance are absent from electro-mechanical systems. Very roughly speaking, feed forward processes generate biological reproduction while feed back processes limit the rate of feed forward processes. Each particular genetic system generates a specific multi-set of feed back and feed forward processes in conjunction with its historical and current situations. Relative to first and second order cybernetics, third order cybernetics is structured by the organization of feed forward processes augmented by feed back processes. Weiner's original electro-mechanical theory of steerage (antecedent to the Boolean logic of Shannon's coding theory) is mathematically inadequate to represent biological feed forward processes. Consequently, third order cybernetics is grounded in a diagrammatic logic and in an electro-chemical theory of information that is capable of expressing biological feed forward messages. The principle mathematic representation of electro-chemical information is as labeled bipartite graphs where each node is an electrical particle with a value. The value may be either a unit or an integer. Both feed back and feed forward processes are represented as logical operations on electro-chemical networks.

A diagrammatic logic for electro-chemical graphs was constructed from the structural representations of the material components of third order cybernetic systems. The basic illations are additive and subtractive. The physical ground for the electrical encoding is the atomic numbers as one source of representation of order. The valence theory of chemistry is a second source of order. A third source of order is the heritable sequences of the particular components of a genetic system. Biosemiosis associates the first, second and third sources of order. The relational logic of Charles S. Peirce is used to image the associations into patterns. Each particular illation is grounded in the physical principles of the conservation of matter and electrical parity.

Electro-chemical logic requires two sorts of quantity, two sorts of graphic nodes. This foundational principle is based on the physical structure of the atom. The antecedence to the two sorts of representations of quantity is the intrinsic attraction and opposition between the two sorts of electrically charged particles. Since, electrically, opposites attract and like repels like, multi-nominal associations of electrical particles into stable configurations require alternating relations between the two sorts of objects. This sortal logic associates independent parts into interdependent wholes under the constraints of electrical parity, the equi-numerosity of the charged particles of an atom, units and an integer. The iconic forms of electro-chemical objects are a particular form of mathematical networks or graphs, termed labeled bipartite graphs. In summary, illations among the atomic numbers, as units and integers, form a system of quantities that expresses a formal system of logic. This formal system of numeric relations is termed the perplex number system. The perplex number system grounds the logic of electro-chemical systems as well as third order cybernetics.

The grammar of third order cybernetics is consistent with both electro-chemical and electro-mechanical steerage. This consistency is achieved by a triangular (tri-partite) commutative diagram that associates (A) the name of an object with (B) the iconic form of the object and with (C) the properties of the object (expressed in the mechanical units of the System International or metric system.) In this context, co-mutative means simply that if any of the three terms (A, B or C) is changed, the other two terms must also be mutated. The verb linking A to B is termed a copulative verb; the verb linking A to C is termed the predicative verb and the formal scientific inferences between B and C are termed the Rosetta relations. C *(properties) can be used as adjectives modifying A. However, the adjectival concept is not applicable to the arc A-B since A and B are formal synonyms, referring to the same object in the natural world. (The International Union of Pure and Applied Chemistry has implemented a formal system of notation for calculating the name from the electro-chemical diagrams.) This narrative of the third order cybernetic grammar uses three different notations to express the formal commutative diagram among the three terms ABC. It resolves the oft-discussed categorical conundrum poised by Robert Rosen (1991) in "Life Itself" by recognizing the proper meaning of notational systems as merely biosemiotic devices that the human community has constructed for purposes of human communication.*

Keywords: third-order cybernetics; biosemiosis; atomic numbers; perplex number system; formal copulative logic; diagrammatic logic; electro-chemical systems; electro-mechanical systems

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Founding member of three Scientific Societies: European Environmental Mutagen Society (ca. 1972); Society for Risk Analysis (ca.1981); Washington Evolutionary Systems Society (ca. 1982)

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Representation of Meaning in the Theory of Meaningful Information

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Abstract: *The Theory of Meaningful Information is a general theory that can be applied to information of every type, level and complexity. The theory explains the nature and functionality of information and enables the production of relevant definitions regarding language and knowledge, which remain operative also in the case of non-human languages and knowledge systems. The non-executable language **T**, built in accordance with the theory, allows creation of code bases functioning in the way of semantic nets, which can be used for the representation of a different kind of knowledge.*

Keywords: general information theory; theory of meaningful information; knowledge representation

The Theory of Meaningful Information (abbr. TMI) is an axiomatic theory based on an overall definition of information, which can be applied to information of every kind, level and complexity. The definition of information enables a view of the world to be seen in terms of objects, actions, relations and properties. Information is considered as the feature manifesting itself in the relations between certain real world entities. The theory provides both the uniform view of all kinds of information and the universal language actually supporting the requested representations.

1. Definition of Information

1.1. The TMI Axiom

TMI presumes that all causal relations in the real world are based on only **four** distinct schemas: — two primitive causal relations occurring under the influence of physical forces and two complex ones. Changed entities are either complex stable objects including several components or systems thereof.

1.2. Detailed Characteristics of Causal Relation Types

1. Changes driven by internal forces.
2. Changes enforced by externally working forces.
3. Changes caused by external non-forceful influence. A changed object (system) has to possess (or have access to) an energy source and an externally controlled activating switch, which opens and closes the energy flow produced/delivered by the energy source.
4. Changes caused by information influence. Similar to the previous change but uses a passive mediating object instead of an activating switch. The state of the mediator is set by an external influence and is queried by the changing object, which alters its own behavior in result of the query.

1.3. Definitions

- **Information** is a state of some mediating object set by some actor called **I**nformation **S**etting **E**ntity (**ISE**) and queried by some reactor designated as an **I**nformation **D**riven **E**ntity (**IDE**).

- The mediating object is a **variable**. Wherefrom follows a yet even shorter definition of information being conceived as a value of a variable used in an algorithm.
- An object, possessing IDE capabilities with or without ISE capabilities, is called **I**nformation **C**apable **E**ntity (**ICE**).

2. Semantics

2.1. Information as a low-level notion

The crosswalk example is used for demonstration of features of information atoms and semantic domains.

2.2. Formal representation of semantics

Representations of information atoms and the meta-schema of informing process are considered on simplest C++ examples.

2.3. Classes of ICE

All currently known ICEs were developed on Earth as a result of the evolutionary process or human engineering. However, their features and structures are very different. Naturally developed unicellular and multicellular organic organisms were followed by social organisms and artificial devices created by the most complex natural ICEs — human beings. Known ICEs can be separated into the following classes based on certain fundamental characteristics:

- unicellular microorganisms - the simplest form of naturally occurring ICEs
- multi-cellular organisms from non-structured sponges up to human beings
- social organisms ranging from primitive organizations like ant colonies up to various created human societies and states. This ICE class is not considered in this work.
- non-computer artificial objects and systems. These are entities, which use the simplest forms of information and are normally unable to produce information. Among them are all devices powered by electrical currents equipped by at least one controlling switch. Such devices also possess various sensors accepting these or other information.
- computers and non-computer systems containing one or more embedded processors (everything from dish-washers up to cars, airplanes etc.)
- components of all aforementioned entities, possessing ICE functionality
- Software entities.

2.4. General structure of representations

The language ***T*** is the representation tool of TMI. Features of semantic networks created with the help of ***T*** code-bases.

3. Representation of human knowledge

- A formal view of a human being constructed in the sense of TMI is designated as Homo Informaticus (HI). A HI is viewed as a self-programming system consisting of a brain (the computer) with the rest of the human body controlled by this computer. The concept of HI is based on the view first formulated by John Lilly [LILLY 1968]. The model allows the expression of the complete information used by a human being, starting from the simplest perceptions and ranging to high-level intellectual functionality.
- Detailed consideration of the structure and functionality of HI.
- The TMI view of neuron.

- Intellectual activity in TMI.

4. Comparison with other theories

- Comparison with Shannon's information theory.
- TMI code bases and conventional semantic nets.
- Concepts of non-formal information-related theories in the terms of TMI.

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Boris Sunik

Born in Lvov (USSR, now Ukraine) in 1955.

Started as a software developer in 1975 at a computing center. Several years later switched to the computing center of the Research Institute of Applied Economy. There I became interested in the search for new principles in programming - a pursuit I have never abandoned. Immigrated to Germany in 1994.

The theory presented on this site is the final result of the intensive research that was begun more than 30 years ago.

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Symposium K. Urban Systems Research

Chairs: J. Alexander Schmidt and Christian Walloth, University of Duisburg-Essen, Essen, Germany

Cities are complex systems of systems. The societal, economic, ecological, technological and political systems are tightly interconnected in the urban system of the city. Urban systems research does thus involve a broad range of cross-disciplinary science. Approaches based on systems theories seem to be predestinated for such cross-disciplinary research. Methods applied to understand urban systems reach from system dynamics models to soft systems approaches and agent based modeling.

This symposium aims at a reflection on different systems approaches in urban systems studies. Using various approaches, scientists as well as practitioners try to understand urban systems, hoping at best to evaluate the system's potential reaction on planned interventions, e. g. policies, let alone a forecast of its behavior. How do these various approaches perform? How exactly do they capture the complexity of the urban system? Which untapped potentials do still lay in the systems approaches? How can they bridge research and policy making, scientists and decision makers? …?

The symposium will present a mix of invited and selected papers and engage the audience in discussions and a workshop. We welcome your contributions on topics laying within or extending the above mentioned scope of the symposium.

Caterina Padoa-Schioppa: Elsewhere City: *Mapping and Diagrams as Generative Tools in Urban Design*

Tom Kauko: *An Evolutionary Approach to Real Estate Analysis – A Demonstration Using Hungarian House Price Data and the Self-organizing Map*

Rüdiger Schultz: *"… the Real Problem": Optimization under Uncertainty – Stochastic Optimization and Urban Systems - Perspectives*

Rainer E. Zimmermann & Silvia Mazzini: The City as Emergent Computational System

Jens Gurr: *"Urban Complexity" from a Cultural Studies Perspective – Key Cultural Dimensions of Urban Complexity and the Challenge of Representation*

Prabir Mukhopadhyay, Vipul Vinzuda, Shital Gohil & Mikhil Sonavaria: *Systems Ergonomics Analysis of a Women Special Bus in India*

Aimen Remida: *Towards a System Theoretical Methodology for Using Agent-based Technology in Modeling Complex Urban Logistics Systems*

Ernst Gebetsroither: *Experiences from Multi-Paradigm Simulation Approaches and how this can Support Urban Planning Decisions*

Christian Walloth: *An Approach to Advance Urban System Modeling*

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Elsewhere City

Mapping and Diagrams as Generative Tools in Urban Design

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***Abstract**: In the past 20 years the research on new methods of design has fine-tuned the development of adaptive prototypical organizations, generative diagrams and responsive systems of description and representation of the built environment. This approach is ground on the paradigm that complexity theories not only have changed our modes of understanding the ongoing dynamics, but also they provide - in any context and with no restriction of scale - programmatic and organizational strategy, while generating formal novelty.*

Keywords: urban growth and the emergence of novel social and economical structures; regimes of complexity and generative techniques in urban design; mapping and diagrams as cognitive and creative tool; associativity and participation

Acknowledgement: Milan Polythecnic; School of Architecture of Roma Tre University.

The exponential growth of built environment in the last half century shows a behaviour that is typical of complex system. At the edge of the planned city, in the transitional zones, more permeable and more dynamic, *frictions* take place and trigger spontaneous self-organization processes. According to many urban investigations started in the late '60s – e.g. in the manifestos by Robert Venturi, Christopher Alexander, Rem Koolhaas - these instable territories are mostly affected by geometrical and functional metamorphoses from which novel social and economical structures emerge.

The loss of spatial and scalar references - derived also by the awareness that cities can not be seen any longer as consistent entities - enhances a disciplinary and instrumental theoretical reformulation. In order to better understanding the evolutive and, to certain extends, the unpredictable character of the environment, the ecological model becomes the new operative framework both for natural and artificial systems. The notion of *multiscalarity* – the coexistence and co-dependence of multiple set of relationships within a single body – adopted to describing urban processes consolidates the idea that any spatial form can be intended as a provisional state, more or less dynamic depending on the partial and subjective observation point.

Thought in ecological terms, also the design process can be seen as the result of steering manipulations and temporal adjustments aiming at engendering provisional conditions of equilibrium between control and freedom, between rigor and error. In this way the new methods are capable not only to develop flexible and adaptive strategies, but also to anticipate formal decisions.

1. Digital techniques and formal novelty in urban design

This leap has dramatically occurred when new digital techniques started to be employed on the one hand to expand the knowledge about complex urban systems, and on the other to simulate, as in any other living structure, their morphogenetic process. The tendency to over emphasize the registration of process and to record complexity mainly as a relational practice very soon triggered a conceptual dichotomy between two different thinking: one searching for strategic outputs, the other for formal ones. Indeed the increasing pressure that the new model of democratic society exerts to delegitimize top-down methodologies in decision making processes has also a role on that tendency. The attempt to "liberate" the architectural language from ideology and to shorten the distance between urban planners and society, is leading to the primacy of strategic approaches versus formal ones. Eventually the sublimation of the concept of unpredictability and of programmatic instability as an aesthetic category, denies and mortifies any systemic formal control and contributes to the actual vulnerability of the role of urban designers.

However, quoting Manuel DeLanda, in social structures, intentional entities - like will and belief – drive decisions, and our capacity to affect those decisions depends on the capacity to keep the balance between a "*methodological individualism"* and an *"ontological holism*" both in observing and acting in dynamic contexts. (DeLanda, 2002)

Some approaches believe that, in order to describe *diversities* in urban fields, it is meaningful to work with techniques that, as in any other complex system, are able to capture the most abstract and creative properties. Maps and diagrams are generative tools that establish a *continuity-simultaneity* between the cognitive analytical moment and the synthetic creative one.

Figure 1: Aereal photo and virtual map of Repubblica Square in Rome (Padoa-Schioppa, 2008)

2. Associativity principle as democratic and participatory device

According to Roland Barthes mapping is not a simply descriptive and objective operation. It is rather a selective procedure, a "form of censorship", coming from the fusion of mental and experiential realm, where intuition and intentionality operate to reveal the comprehensive system of relationships between the ongoing multiple dynamics of a territories - cultural, economical, social and political - beyond the physical ones. (Barthes, 1999)

Before assigning scale and function, we can investigate the potential of a material system – an organisation where we perceive an *integrated intelligence* between formal and functional factors, like in spontaneous architecture, in natural structures and in construction principles - by acquiring knowledge within a set of geometrical rules, yet without being constrained by intentions and conventions. Diagrams indeed have the capacity of gathering virtual information and making formal configurations emerge, while interlocking all the steps between ideation and fabrication of ideas, like in a long productive chain.

This principle – as in cad/cam technologies – is called *associativity*.

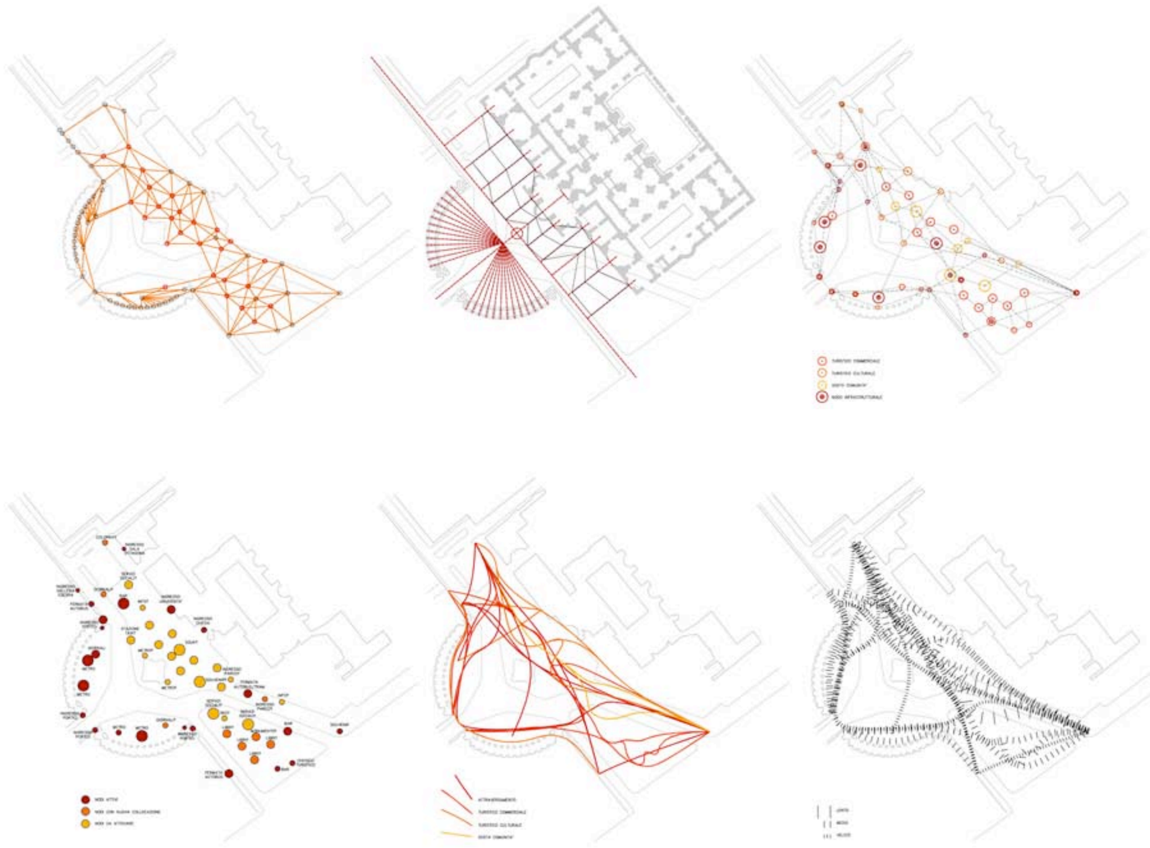

Figure 2: Sequence of diagrams of pedestrian flows and activities in the square obtained with a consistent system of geometric rules that inform formal decisions (Padoa-Schioppa, 2008)

Moreover, the abstraction of the material is an essential device for interdisciplinary collaboration, collective manipulations and social participation. The *illegibility* of maps and diagrams facilitates multiple visualizations: while postponing objects' definition, it unfolds all the imaginative contents in idea's sedimentation process.

After all, the adaptability to different interpretations and needs has an essential social and relational task: it reduces the gap between the strategic visions and the prescriptive requirements in the urban design process. But also it has the potential to restore the historical architect's role who is asked to introduce figurative and formal feature in the design of infrastructures.

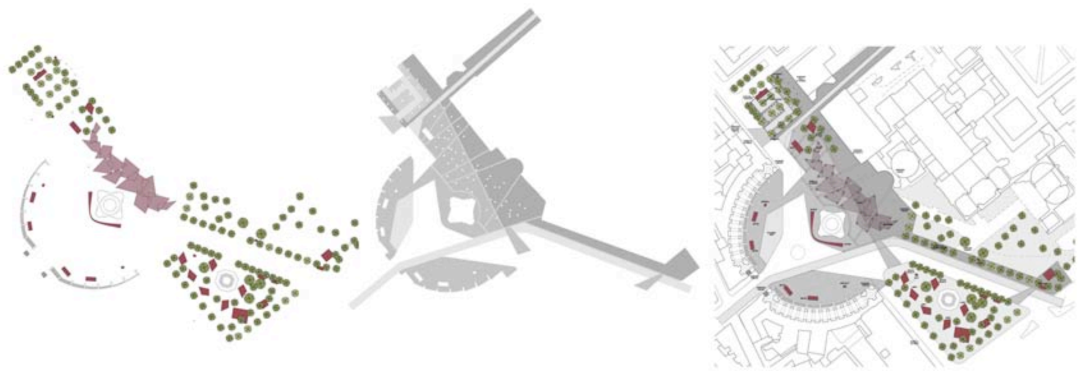

Figure 3: New configuration of the square (Padoa-Schioppa, 2008)

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Caterina Padoa Schioppa

Caterina Padoa Schioppa *(1974) is an Italian architect and researcher based in Rome. After her Diploma (hons), between 2000 and 2002 she works in Paris in various architectural firms. In 2003 she attends the Master Degree in Landscape Urbanism at the Architectural Association (AA) in London. Back to Rome, in may 2009 she got her PhD in the School of Architecture of Roma Tre University with a thesis called “Transcalarity and adaptability in Landscape Urbanism” which has been published in 2010 by Aracne Editrice/Rome.*

Since 2004 she started her teaching experience in several academic contexts mostly lecturing and engaging in experimental workshops. She is regularly invited as Guest Critic at the Harvard GSD, AA and the Bartlett of London, TU Delft, IUAV University of Venice, and of course at Roma Tre University. She is currently teaching at the Milan Polythecnic. She has been.

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An Evolutionary Approach to Real Estate Analysis

A Demonstration Using Hungarian House Price Data and the Self-organizing Map

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Abstract: *Evolutionary economics has begun to replace – or at least complement – neoclassical economics as the most widely accepted framework for economic modeling. This is indeed the case in urban and real estate economics too. Evolutionary frameworks are nonlinear and iterative: they take their starting point in the divergence of routines and outcomes of business activity over time, and work on the assumption that this diversification subsequently leads to a selection-of-the-fittest mechanism. In real estate analysis the issue is about market outcome and the behavior of actors such as developers and investors. Thus a feasible method needs to apply both real estate transaction price data and expert interviews about actor motivations and tendencies. On top of the price development target urban sustainability is incorporated as a more qualitative target as the aim is to compare the price development with various sustainability aspects across a variety of locations and typical market segments. This demonstration uses data on Budapest (1,7M inhabitants; the capital of Hungary) and Szeged (170,000; third biggest city in Hungary) together with a quasi-dynamic modeling approach based on the self-organizing map (SOM) and fixed time-windows.*

Keywords: evolutionary economics; real estate; the self-organizing map (SOM); urban sustainability; Budapest; Szeged

Acknowledgement: Thanks to KSH (The National statistical office in Hungary) and to all interviewed Hungarian experts for making this research possible.

1. Introduction

Since the seminal book by Nelson and Winter (1982) has evolutionary economics begun to replace – or at least complement – neoclassical economics (NCE) as the most widely accepted framework for economic modeling. This will inevitably also be the case in applied fields such as urban real estate economics. This apparent turn is on one hand influenced by debates concerning the methodology of economics, but also is on the other hand a result of the incorporation of sustainable development criteria onto studies on the built environment (e.g. Støa, 2009), as the relatively recent sustainable development debate has shown the case for incorporating the evolutionary perspective into real estate and urban economic analysis. Moreover, this discussion has already moved beyond the narrow concept of sustainability that is recognized by NCE and defined simplistically in terms of the balance between costs and benefits. The crucial difference between the two modeling traditions is that evolutionary approaches (including the Austrian school of economics), allow for feedback between outcome and process, and emphasize behavioral factors and complexity in business routines on top of the market outcome data employed by standard NCE approaches.

In the present contribution the urban and real estate sustainability topic is approached through a methodological framework based on the self-organizing map (SOM) and evolutionary economics. The particular issue in the current research concerns the plausible extent to which the price development observed in a given place is ‘normal’ or caused by some relation to issues that can be defined along the categorization of sustainable and unsustainable development issues? The analysis is based on expert interviews together with some descriptive data on paid transaction prices. The analysis of sustainable property development within Hungarian housing market circumstances is here an atypical case in point. The case study focuses on the residential sector in the cities of Budapest and Szeged (data 2000- 2009).

2. An Evolutionary Framework for the Analysis of Real Estate Price Development and Urban Sustainability

Cities cannot be understood without a relation to real estate development and markets. In this context the evolutionary arguments are based on a set of logical assumptions of the complex mechanisms that define the trajectory of events unfolding in given urban circumstances. Depending on the time of development and the area's current image different parts of the city are likely to experience upward and downward developments in the value of their real estate stock. Any investment (or lack thereof) will either enhance the potential of that location, thereby attracting further investment and increasing the value even further, or lead to dilapidation, a loss in potential, absence of investment and further decreases in the value. It should also be noted that either trend can be reversed; inappropriate structures may generate a downward trend in the price movements and development activity, or/and gentrification of a neighborhood will lead to an upward trend. Some of the theory of housing market modeling has included these mechanisms and assumptions implicitly (see e.g. Maclennan and Tu, 1996; Kauko, 2006).

Evolutionary frameworks are nonlinear and iterative: they take their starting point in the divergence of routines and outcomes of business activity over time, and work on the assumption that a diversification leads to selection-of-the-fittest. This would require heterogeneity in product ranges, which in turn is fostered by flexible and market sensible administrative structures and is influenced by the changing tastes of consumers. In real estate the issue is about market outcome and the behavior of actors such as developers and investors. Thus a feasible method needs to apply price data together with expert interviews about the motivations and tendencies of actors.

Sustainable development comprises three basic dimensions: the environmental-ecologic (green buildings/developments); the social-cultural, and the economic-financial. The most common and theorized dimension is the green aspect. The other two categories are less developed in terms of analytical frameworks. Here it is worth noting that, despite the lack of an agreed consensus within academia, practitioners have been quick in picking up this framework. In particular, an evolutionary perspective to real estate sustainability has recently been championed by RICS, the leading global advisory body on built environment issues (e.g. Macintosh, 2010; Ratcliffe et al., 2010).

3. The Quasi-dynamic Modeling Approach based on the SOM

The study follows in the footsteps of earlier works where the SOM (essentially a clustering and classification technique based by a set of neural network algorithms invented by Teuvo Kohonen in 1982, see fig. 1) has been used by the same author: Kauko (2007) comprised a cross-sectional analysis of Budapest house prices; Kauko (2009) in turn comprised a quasi-dynamic analysis using the fixed time-windows method originally proposed by Carlson (1998) for two adjacent inner city neighbourhoods of Budapest (see fig. 2). Nonetheless, the SOM is only able to deal with outcome data. To target the relevant processes we need to triangulate with qualitative information.

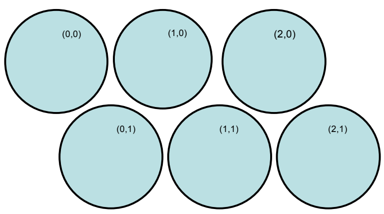

Figure 1: The situation of the nodes in a three-by-two (3x2) map

Figure 2: The method of fixed time-windows

The anticipated research findings are both methodological and empirical. Any conclusions would thus address both aspects: one, the innovative value of the triangulated approach where qualitative factors are combined with the SOM and the compatibility of such a methodology with an evolutionary theory framework; and two, the country- and city-specific results from the two case studies regarding house price development patterns and urban sustainability tendencies.

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Tom Kauko graduated in December 1994 as MSc in Land Surveying at Helsinki University of Technology (HUT), with major in Real Estate Economics and Valuation. During 1995-96 he worked as a planner for the research department of National Land Survey of Finland in Helsinki (*Maanmittauslaitos*). In October 1998 he moved to Utrecht University, Faculty of Geographical Sciences, where he defended his PhD in June 2002. From September 2001 until September 2006 he held a research position at OTB Research Institute for Housing, Urban and Mobility Studies, Delft University of Technology. In October 2006 he was appointed Associate Professor at the Department of Geography at the Norwegian University of Science and Technology (*NTNU*). Since 2007 he is the leader of their Urban, Rural and Regional Research Group. His research interests cover urban affairs related to real estate and sustainable development.

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“... the Real Problem”: Optimization under Uncertainty

Stochastic Optimization and Urban Systems - Perspectives

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Abstract: *Stochastic Optimization offers methodology for mathematically rigorous and computationally efficient treatment of optimization problems with random data. Optimization problems in urban systems often contain random data. Therefore, both stochastic optimization and urban systems may benefit from each other. In the talk we show how.*

Keywords: mathematical optimization; urban systems; decision making under uncertainty; stochastic programming; network optimization; transportation; commodities

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1. Motivation

To George B. Dantzig, one of the founders of optimization as a mathematical discipline, it is attributed that, once cutting roses in his garden and talking to a doctoral student, he said: “You know, the real problem in optimization is uncertainty.”

Today, more than 50 years later, this observation has not lost its validity. With focus on urban systems, our talk is devoted to some reflections on this topic. Urban systems, like many other complex entities, typically involve processes and structures whose design and operation have to be optimized without the full data information.

An example is deciding on the cost-optimal layout of a transportation network under uncertainty of future operation. The term “transportation network” stands for a range of specifications whose common feature is critical dependence on some network structure. These can be a street network for traffic or supply grids for commodities like electricity, heat, water, or natural gas. Uncertainty enters, for instance, via traffic demand, input of renewables into power grids, commodity prices, or reliability of operation of network components or the network as a whole. Obviously, in all these circumstances, the layout must be fixed before operation begins, i.e., decisions be taken with incomplete information, or, in other words, without anticipating future information at the moment of taking the decision. This “nonanticipativity” is a crucial condition in optimization under uncertainty.

In this abstract, we demonstrate at a small example, still solvable “by hand”, how uncertainty may icause fundamental changes in the nature of optimization problems. In the talk we will pick up this issue and present modern mathematical methodology enabling the solution of real-life optimization problems under uncertainty.

2. The Difference Uncertainty Makes

In preparation for the winter season, a municipal utility must decide how much de-icing salt to purchase in advance for a price $c>0$ per unit of salt. When running out of salt during the season, salt can be back ordered for a price $b>c$, on a day-by-day basis with precise knowledge of the salt consumption for the day to come. Disposal or storage of salt, left over at the end of the season, entails a cost of h>0 per unit. How much salt shall be purchased in advance such that the total cost of advance purchase, back order, and storage becomes minimal?

Let x denote the amount of advance purchase and d be the total salt consumption over the winter season. Then the total cost F(x,d) the municipal authority wishes to minimize reads

$$F(x,d) \quad = \quad cx \quad + \quad b\ \mathit{max}\{d\text{-}x,\ 0\} \quad + \quad h\ \mathit{max}\{x\text{-}d,\ 0\}.$$

Here the max terms denote the maximum of the numbers in brackets thereafter. Without uncertainty, i.e., when knowing d at the moment of advance purchase, there is nothing to optimize: Since back order is more expensive than advance purchase there is no sense to purchase in advance less than d units of salt. Because storage entails costs greater than zero, purchasing more than d cannot be optimal. Hence, the cost F(x,d) is minimized for x=d.

Of course, this clairvoyant approach is inadequate since, in reality, d is uncertain at the moment of fixing the advance purchase x. In stochastic programming, probability distributions are associated with uncertain model parameters. Technically speaking, what has been a real number now becomes a (measurable) real-valued function whose range coincides with the possible realizations of the uncertain parameter. In our example, the uncertain real number d is turned into the real-valued random variable **d**. (We take the convention that random variables (functions) are displayed in bold face, while their realizations (numbers) in standard font.)

For the cost, the number F(x,d) turns into the random variable F(x,**d**) assigning, for given advance purchase x, to each realization d of **d** the total cost F(x,d). To rank different advance purchases or numbers x' and x'' in the presence of uncertainty, requires to rank different functions, namely F(x',**d**) and F(x'',**d**), what is much more delicate than just putting numbers in some order.

A popular possibility to proceed is assigning a unique real number to each (function or) random variable F(x,**d**), most prominently, its expected value *E*[F(x,**d**)]. Random variables then are compared according to these numbers, leading to the minimization problem *Min E*[F(x,**d**)].

This problem aims at finding an advance purchase x minimizing the expected value of the random costs arising from the sum of the deterministic advance purchase and the random adjustments (back order, storage/disposal) caused by the random realizations of the salt consumption. Let us mention that *E*[F(x,**d**)] is a convex function in x. This allows for explicit determination of its global minimum over the nonnegative reals. The optimal solution is given by the equation

$$H(x) \;=\; (b - c)/(b + h).$$

Here H denotes the cumulative distribution function of **d**, i.e., H(x) is the probability that the random salt consumption is at most x. This yields the optimal x as the (b – c)/(b + h)-quantile of H.

One might ask: Why this tedious calculation and not replacing random data by their expected values, leading to a deterministic model whose solution is immediate?

Take the above example with specific data. The random variable **d** follows a uniform distribution on the interval [0,100]. Let the back order price be twice the price of advance order (c=0.5b) and the price for storage/disposal be nine times the price of back order (h=9b). Replacing the random variable **d** by its expected value *E***d** and solving the resulting deterministic problem yields the "optimum" at x = *E***d** = 50. Minimizing the expected value of total cost, a procedure, much closer to the real flow of information, yields, via the above quantile formula, the optimum x* = 15. This is strikingly different from the above "optimum" x = 50. The expected total cost of x* amounts to 48.75 b, while for x= 50 this cost is 150 b, i.e., more than three times the cost of the true optimum.

In the "deterministic world", advance purchase and future consumption coincide, such that there is no need for back order or storage/disposal. The asymmetry of their costs remains hidden, but strikes as soon as the slightest dispersion of **d** really matters. Since storage/disposal is so much more expensive than back order, overpurchasing in advance has a much higher risk to produce excessive total costs than underpurchasing. As a consequence, in the mean, x=50 is prone to cause three times the costs of x*=15, which is the optimum.

3. Stochastic Programs for Urban Systems: Dispersed Power Generation

In the talk, we illustrate at urban supply networks the basic facts on modeling, algorithm design, and computations for stochastic programs. Objects of study are dispersed generation systems. These innovative structures in power generation, consist of small dispersed units, often involving renewables (wind, solar energy), and usually are located close to consumers. This promotes sustainability by reduced transmission losses and more efficient exploitation of heat as coupled product (cogeneration units for power and heat). Regarding investments, dispersed generation systems are attractive due to short depreciation times compared with traditional power units.

Dispersed generation systems sometimes are called virtual power plants since they do not represent a physical power unit but rather a virtual one by their controlled interaction. It is commonly acknowledged that this poses substantial new challenges to computer aided system control. Municipal utilities are typical operators of virtual power plants. Their principal task can be summarized as *maintaining reliable and cost efficient supply under uncertainty of load, power price, and power input (wind, light) – and this in such a manner that, at best, the company, in addition, is earning money at a liberalized electricity market*. Decision problems of this kind are extremely complex and must be solved routinely several times a day. Even most experienced practitioners then need quickly available decision support, the hour strikes for mathematics.

For testing models and algorithms, we consider a virtual power plant consisting of cogeneration units, wind turbines, and a small hydroelectric power plant. Power is fed into the global grid, enabling electricity trade at energy markets. Heat is fed into local networks around each cogeneration station. Uncertainty is present at the input side by the infeed from wind turbines, and at the output side by power and heat demand as well as power prices.

4. Models, Algorithms, and Preliminary Computations

Model Building: For the mentioned virtual power plant we formulate a two-stage stochastic programming model optimizing its operation over some time horizon. For an initial time period of four hours, data are assumed known (resulting from reliable estimates). For the rest of the day, discrete probability distributions describe input from renewables. At the output side, power demand and power prices are random. With all relevant operational constraints, revenues (trading income minus fuel costs) are maximized. Both risk neutral models, based on expected values, and models with risk aversion involving risk measures or stochastic dominance constraints are presented.

Algorithm Design: With discrete probability distributions, our stochastic programs are large-scale mixed-integer linear programs whose different block structures give rise to decomposition methods. We present tailored methods for individual problem classes: risk neutral or risk averse, with or without integer variables, and using or not stochastic dominance of different orders.

Case Studies: Our intention is to show that mathematical methodology for integrated treatment of uncertainty in an optimization context is mature enough to tackle successfully real-life decision problems. In particular by the mentioned decomposition, our methods outperform commercial all-at-once solvers if problem dimensions become large. Our computational tests are integrated into small case studies concerning practical optimization problems inspired by the dispersed generation system from section 3 and by a retailer problem in power trading.

5. Bibliographical Remarks

The seminal papers on stochastic programming are (Dantzig, 1955) and (Beale, 1955). Recent textbooks are (Shapiro & Dentcheva & Ruszczynski, 2009) and (Kall & Mayer, 2005). A broad range of applications of stochastic programming is presented in (Wallace & Ziemba, 2005). Further details on the topics discussed in the talk can be found in (Handschin & Neise & Neumann & Schultz, 2006), (Gollmer & Neise & Schultz, 2008), and (Schultz, 2003). Although not listed explicitly under the keyword Urban Systems, there is a number of branches in stochastic programming dealing implicitly with aspects relevant for urban systems. Those are vehicle routing (Laporte & Louveaux & Mercure, 2007), supply chains (Santoso & Ahmed & Goetschalckx & Shapiro, 2005), project planning (Demeulemeester & Herroelen, 2002), traffic and transportation (Powell & Topaloglu, 2003), and, last but not least, energy systems (Handschin & Neise & Neumann & Schultz, 2006), which we have chosen to demonstrate today's and envision tomorrow's contributions of stochastic programming to urban systems.

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Born in 1959, he studied, from 1977 on, Mathematics at the Humboldt University Berlin. From the same university he obtained his PhD in 1985 and his Habilitation including university teaching permit Venia Legendi in 1995. From 1988 to 1989 he stayed at the Institute of Operations Research of the University of Zurich, funded by a grant of the Swiss Confederation. In 1993 Schultz joined the Konrad-Zuse Center Berlin (ZIB) as a research collaborator in the Department of Optimization. In 1997 he was appointed Associate Professor in the Mathematical Institute of the University of Leipzig. In Since 1998 he is Full Professor for Discrete Mathematics and Optimization in the Department of Mathematics of the Gerhard-Mercator University Duisburg, today University of Duisburg-Essen.

His main fields of research are Stochastic Optimization, Mixed-Integer Optimization, and Industrial Applications of Optimization. The latter mainly in the Power and Gas Industries and, more recently, in Logistics. Schultz is author or co-author of about 60 peer refereed research articles in journals and edited volumes. His research has been co-funded by government authorities (DFG, German Research Association; Federal Ministry of Education and Research) as well as private companies (Vattenfall Germany, Ruhrgas, MAN Turbo, e-on Gas Transportation, now Open Grid Europe (OGE)).

As university teacher, Schultz has supervised 11 completed PhD projects. Currently, he supervises 6 PhD students. He is on the editorial boards of Operations Research Letters, Mathematical Methods of Operations Research, Stochastic Programming E-Prints Series, RAIRO Operations Research, Euro Journal on Computational Optimization, and Vietnam Journal of Mathematics.

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The City as Emergent Computational System

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Abstract: *Complex urban space as representation of city quarters visualized as emergent computational systems are being discussed, both in technical terms by means of category theory, and in hermeneutic terms by means of semiological approaches.*

Keywords: complex systems; evolutionary systems; networks; spaces; logic; hermeneutic

Essentially, two basic topics are involved in discussing the structure and evolution of urban space in terms of emergent computational systems: On the one hand, in formal terms, the processes referred to can be visualized within a chiefly mathematical framework originally introduced by the protagonists of the Santa Fe school in the eighties and nineties of the last century. As it turns out, it is this kind of treatment that identifies the topic with fundamental aspects of systems. On the other hand, social space, by being also defined in terms of properties, which surpass the purely formal description, is subject to hermeneutic connotations, which can be well treated within the framework of semiological techniques. The main result is to show that social space can be defined as a (mathematical) topos such that it is represented as a space whose points are narrative models of pre-scientific (everyday) theories. If so, on the one hand, an explicit design of the ruling discourse within a given social space (such as an urban quarter e.g.) can be expected to influence the felt living conditions under criteria of harmony, while on the other hand, the explicit design of physical details (architecture, topology) can be expected to influence the discourse, respectively. This research is part of the program on "space & language"[1], part of a larger program on design science visualized as a meta-theory.

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"Urban Complexity" from a Cultural Studies Perspective

Key Cultural Dimensions of Urban Complexity and the Challenge of Representation

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Abstract: *The contribution outlines a literary and cultural studies approach to urban complexity: What are key dimension or urban complexity from a cultural studies perspective? How can these complexities be represented in cultural production? What can cultural studies contribute to interdisciplinary engagements with urban complexity?*

Keywords: urban complexity; cultural studies; simultaneity; representation; interdisciplinary urban studies

There are few explicit attempts at engaging with urban complexity from the perspective of literary and cultural studies, though 'complexity' has long been recognized as a key characteristic of urban life. Three examples may suffice: In his influential 1903 essay "The Metropolis and Mental Life," Simmel speaks of the "*intensification of nervous stimulation* which results from the swift and uninterrupted change of outer and inner stimuli" and the "rapid crowding of changing images, the sharp discontinuity in the grasp of a single glance, and the unexptectedness of onrushing impressions [as] the psychological conditions which the metropolis creates" (Simmel, 1903, p. 13, italics original). In her equally classic 1961 *The Death and Life of Great American Cities*, Jane Jacobs celebrated the "urban ballet" (p. 54) of bustling street life and diversity. Out of Jacobs's four main requirements for a thriving city—mixed-use areas, mixed building types, ages, sizes and conditions in close proximity, population density, and small blocks—the first three arguably describe facets of 'complexity.' Finally, in one of the most recent and ambitious attempts to provide urban studies with an integrating paradigm, Frank Eckhardt in his masterful study *Die komplexe Stadt: Orientierungen im urbanen Labyrinth* (2009) goes so far as to propose complexity as *the* key characteristic of the city to serve as a foundation for urban research generally.

From the perspective of literary and cultural studies, the question is how the complexity of the urban text is represented in literature and other media. In his 2005 study *Imagined Cities*, Robert Alter stresses the "intimate relationship between the novel and the city" (p. ix). In a less universal manner, Raymond Williams points out that "there are decisive links between the practices and ideas of the avant-garde movements of the twentieth century and the specific conditions and relationships of the twentieth-century metropolis" (p. 59, cf. also Keunen & Eeckhout, 57). As for the connection between the city and film, Laura Frahm, in a recent study on filmic creations of urban space, speaks of the "elective affinities between the metropolis and film" (Frahm, 2010, p. 182, my translation). Similarly, in his introduction to an excellent volume on *Cinema and the City,* Mark Shiel describes a key relation between the city and film thus:

> *"This book is concerned with the relationship between the most important cultural form—cinema—and the most important form of social organization—the city—in the twentieth century (and, for the time being at least, the twenty-first), as this relationship operates and is experienced in society as a lived social reality."* (Shiel, 2001, p. 1)

However, despite the universally diagnosed importance of complexity as a key characteristic of the urban and the widely perceived affinity between the city and both the novel and film—and the wealth of material on the city in literature and film—, the specific issue of how literary texts represent urban complexity has received very limited explicit scholarly attention.[1]

This contribution sets out to show how literary and cultural studies might engage with urban complexity. What, one might ask, would be dimensions of urban complexity from the perspective of cultural studies – overlapping and intersecting spatial scales and their interdependencies, ethnic and cultural diversity and heterogeneity, the multiplicity of sense impressions and the resulting sensual overload, semiotic "overkill" as a result of a multiplicity of sign systems and ceaseless semiosis, for instance – and how can these various aspects of complexity be represented in cultural production (literature, film, the arts)? The contribution will argue that the primary representational challenge lies in the representation of simultaneity and will sketch a number of strategies used in cultural production to represent simultaneity. Finally, it will ask how an understanding of these issues might contribute to an interdisciplinary engagement with urban complexity. To what extent are cultural strategies of mapping, negotiating and reducing complexity comparable to those current in other disciplines?

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Jens Martin Gurr, born 1974, studied English and German at the University of Mannheim. He received his doctorate from the University of Duisburg for his thesis *Tristram Shandy and the Dialectic of Enlightenment* (Heidelberg: Universitätsverlag Winter, 1999). His post-doctoral thesis *The Human Soul as Battleground: Variations on Dualism and the Self in English Literature* was published in 2003 (Heidelberg: Winter). Having taught at the universities of Duisburg-Essen, Bamberg, and Waterloo, Canada, he has been Professor of British and Anglophone Literature and Culture at the University of Duisburg-Essen since April 2007. His research interests include urban studies, urban popular culture, urban literature, the politics of

[1] In this vein, in his fascinating account of New York in film, *Celluloid Skyline: New York and the Movies*, James Sanders uses the much-quoted line from the final voice-over in *The Naked City*—"There are eight million stories in the Naked City"—to title one of his chapters "Eight Million Stories" (Sanders, 2003, p. 325-364). Here, he does refer to the potential of films shot on location to "present the genuine scale and complexity of the city" (Sanders, 2003, p. 331), but—like most other studies of the kind—does not systematically engage with the issue of urban complexity and the strategies of representing it.

identity in the Americas, contemporary Anglophone fiction, film and film theory, 17th- and 18th-century British literature and British Romanticism. He is director of the University of Duisburg-Essen's Main Research Area "Urban Systems". His most recent publication is a co-edited collection of essays on representations of urban complexity: Jens Martin Gurr, Wilfried

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Systems Ergonomics Analysis of a Women Special Bus in India

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Abstract: *In different states in India regulations are in place in the domain of transportation to ensure safety and comfort of the passengers, especially the women passengers. Unfortunately the focus has only been on increasing the number of buses in the routes at different times without focusing on other issues. This has resulted in increasing inconvenience among the women passengers and especially the daily commuters who need to travel to earn their living. Majority of the buses plying in these routes are verbatim copies of the buses in the Western World, where the needs and culture of the people are completely different. Hence such buses are actually perceived as "foreign implants" in an Indian context by the commuters. Methodology like direct observation, questionnaire technique, interview, measurement of the dimensions of the bus pertinent to human body dimensions and movement were applied.*

Keywords: India; transportation; cultural needs

The paper looked into women's special bus in India from the following System's perspective:

1. Overall interaction pattern of Indian women when they travel all alone.
2. The needs and wants of women when they are travelling
3. How the dress/attire of the women could influence the interior design of the bus
4. Group formation pattern if any for such women who travel daily.

Objective of the study was:

1. To make the public transport system more user friendly for women
2. To encourage women to use public transport system ensuring their safety and respecting their privacy at the same time.
3. To discourage use of private vehicles and thus reduce environmental pollution.

Results of the study revealed many interesting facts like the attire of the majority of women was "sari" which is a piece of cloth wrapped around the body. This specific attire often came in the way while trying to get up and down from the bus during rush hours. It was revealed that majority of the women being a little bulky had problems in seating comfortably within the bus. Many passengers wished to groom themselves before getting down from the bus while on their way to the office and had to use the rear view mirror of the bus for the purpose. The passage inside the bus was too narrow and did not allow any personal space for the passengers. There was too much use of black color inside the bus, which was disliked by the passengers as black was considered as an inauspicious color by majority.

Based on the user study and the feedback from the users different concepts of the interior of the bus was put forward. The concepts are being forwarded to the respective authorities for immediate implementation.

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Towards a System Theoretical Methodology for Using Agent-based Technology in Modeling Complex Urban Logistics Systems

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Abstract: *In order to contribute developing a theoretical framework for using multi-agent systems (MAS) in urban logistics systems modeling, I suggest to start with highlighting the interdisciplinary character of urban logistics research (section 1), then to focus on the urban subsystem of mobility and outline the most relevant applications and methodologies of (MAS) in logistics (section 2). Since the suggested methodology is rooted in early general systems theory, I propose to review some significant approaches to general systems theory and to point out the required methodological steps to assist research efforts using (MAS) in modeling interdependent urban subsystems (section 3).*

Keywords: multi-agent system; urban logistics; system theory

Introduction: An urban area is the location of concentrated and multisided human activities; it presents a complex "system of systems" including connected agents and interrelated phenomena. In order to analyze, understand and model this kind of systems, a predefined dissection of the system into components is necessary to take into account different research fields and their corresponding disciplines which allow considering the urban entities and phenomena from various perspectives. In this paper, I suggest a system theoretical methodology to assist applying agent-based technology in modeling substantial interconnected parts of an urban system (urban subsystems) by distinguishing two dissection possibilities of the urban system: the first, theory oriented, rests on considering a variety of disciplines with an intention of looking for similarities and common phenomena. The second, more practical, deals with defined entities, which may be seen from an interdisciplinary point of view but still belonging to a same level of complexity. The consideration of both urban system morphologies could assist the conceptualization and design of intelligent agents.

1. Interdisciplinary Character of urban logistics research

Urban mobility could be considered as a subsystem of the urban system and logistics with its engineering and management scopes could be defined as science of mobility since it deals with interacting technical, social and economical aspects related to the flows of physical and virtual entities such as goods, people, forms of energy and information. The investigation of the movements and storage processes of those urban entities leads to detect the need for modeling interdependent urban logistics systems such as warehousing, supply chain network, passenger and freight transportation patterns. Urban logistics research is therefore basically concerned with various disciplines, which may include, among others, supply chain management, macro- and microeconomics, geography, urban planning and computer science. Moreover, urban logistics systems involve several urban entities and stakeholders with corresponding characteristics, abilities and behavioral properties. To model the increasing complexity of the interconnections between these agents, one must take into consideration the behavior of each of them within the dynamic and vulnerable environment. Among the most powerful tools for handling such a level of complexity are modularity and abstraction [1], agent technology is a helpful means in modeling complex logistics systems since it makes them modular.

2. Applications and methodologies of (MAS) in urban logistics:

Broadly speaking, one could classify agent applications by type of the agent, by the technology used to implement the agent or by the application domain itself; industrial, commercial, medical and entertainment applications present the main categories [2]. As far as supply chain and logistics systems modeling are concerned, agent technology aims to provide new concepts and abstractions to facilitate the design and implementation of distributed and heterogeneous systems such as software for automation of, and decision support for logistics management [3]. (MAS) are used for various logistics applications (e.g. container management, rail transportation scheduling, vehicle dispatching, logistics planning, traffic regulation and simulation) to model decision-making, negotiation, coordination and co-operation processes involving private companies, public organizations and residents of the urban area [4]. In such complex urban logistics systems, (MAS) applications are expected to tackle problems related to both social and natural sciences, they should be able to model several urban processes within complex interrelated natural, economic and social phenomena. The top-down methodologies used in manufacturing and logistics research are based on the assumption that knowledge is outside the "system" and the observable phenomenon of interest could be measured and analyzed and therefore decomposed correctly to different sub-units where the sub-problems are solved separately [5]. Those models, also called observables, are based on global performance measures and de-emphasize the relationships and dynamics, which in reality exist within the system to model [6]. In contrast, agent-based bottom-up approaches, which are implemented in more pragmatic logistics research, with extractable empirical data, are dealing with activities, machines, and operations on their most concrete level, i.e. there is no need to consider the whole phenomenon at once [5]. To overcome the limits of each separated methodology, the system theory paradigm could offer helpful insights.

3. A system theoretical Methodology

3.1. A review of two relevant system theoretical approaches

In his work titled "General systems theory-The skeleton of science", Kenneth E. Boulding identifies two main approaches to general systems theory; the first approach is to detect common phenomena one may observe in several disciplines, and to attempt to construct general theoretical models related to these phenomena. The interaction of an "individual" with its environment could be such a system phenomenon, or it could be the phenomenon of growth, which may be found in almost all disciplines. The second approach is to focus on the empirical fields and arrange them in a hierarchy according to the organizational complexity of their elementary "individual" or unit of behavior, and to try to develop a level of abstraction appropriate to each [7].

3.2. Methodological steps

After defining the used terminology[1], my suggestion is to proceed analogously to Building's dichotomy by transferring it to the urban sphere and hence distinguishing two possible system theoretical morphologies of the urban system, the first allows to exhibit the common phenomena among the urban subsystems, as well as to break them down into processes and to look for the potential executing agents, while the second highlights the potential properties of an urban entity and hence the characteristics of an agent. Within this system theoretical perspective, I identify following methodological steps:

1 One needs to define the specific meanings of the terms used in this particular methodological context, such as: system, subsystem, phenomenon, process, entity, property…etc.

1) Dissection morphologies and Extraction of subsystems and entities: The dissection of an urban system into parts could occur regarding the involved disciplines (Discipline-based morphology) or taking into account the level of complexity of some studied entities (Abstraction-based morphology). In a classification into domains, one may consider, among other concepts, the economical, social, geopolitical, or ecological scopes of an urbanized space. As far as entities are concerned, one could extract several objects or subjects of various empirical studies (e.g., vehicles, workers…).

2) Assignment of phenomena and hierarchical levels of complexity: In this step, I suggest to assign the observed urban phenomena to a number of subsystems from the many extracted in the first step. At the same time each considered urban entity is assigned to a corresponding level of complexity. Within his approaches to general systems theory, Boulding listed nine levels of theoretical discourse: static structures / simple dynamic systems / cybernetic systems / open systems / genetic-societal systems / animal level / human level / social organizations and transcendental systems [7].

3) Detection of the common phenomena and its processes, as well as the properties of the entities in each complexity level: In this stage, and after decomposing the detected common phenomena into processes, one needs to point out the possible relations between these processes and the properties of the entities (already assigned to levels of complexity in the previous step); a potential solution could be the consideration of three analogous levels of urban processes: the macro (societal), meso (institutional) and micro (individual) levels.

4) Deduction of agents groups (AG) from association matrices and preliminary associations groups (PAG): Using the relations between the phenomena (processes) and the entities (properties) pointed out in step 3, agents groups are shaped on the base of the intersection between the (PAGs) after identifying “which processes in which subsystem” and “which properties for which entity”. These identifications occur by using combination matrices, which lead to some early associations, needed to grasp the final feature of the expected agent-based system modeling.

4. Conclusion

The suggested methodology attempts to take into account various urban subsystems and several urban phenomena and entities, which is essential to model complex and dynamic systems. However there is a need for investigating the relationships between the urban processes, one could find within urban phenomena, and the properties an urban entity have to acquire in order to be modeled as an agent in a multi-agent system.

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Experiences from Multi-Paradigm Simulation Approaches and how this can Support Urban Planning Decisions

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Abstract: *In the past modelers had often a too tight engagement with one method what sometimes produces a blockade to use new approaches. The paper will discuss why nowadays multi-paradigm simulation gains more and more supporters and what are main advantages and disadvantages of it. This will be discussed theoretically as well as underpinned with recently finished and currently ongoing simulation projects. Briefly already available software tools as well as general requirements for such tools supporting modelers in multi-paradigm modeling will be discussed too. A main part of the paper will discuss how an Urban development model can gain from a multi-paradigm approach and therefore support policy makers and urban planners in finding valid and more accepted measures.*

Keywords: agent-based modeling; urban development; multi-paradigm simulation; modeling; stakeholder involvement; interactive simulation; spatial simulation

1. Finding the best modeling paradigm

Lorenz and Jost discuss that finding the best modeling paradigm is concentrated around three main dimensions: the modeling purpose, the object and the methodology presenting the following triangulation (Lorenz & Jost, 2006).

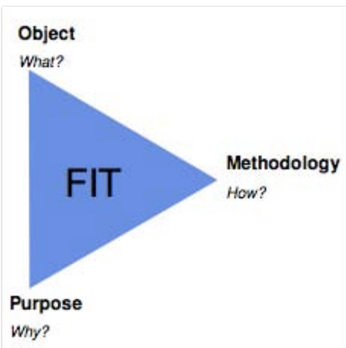

Figure 1: Purpose - Object - Methodology Source: (Figure 1 from Lorenz and Jost, 2006)

“Object” in this context is the world under investigation, the “what to simulate”. Both the structure and the detail of the available information are important issues for the choice of the modeling approach.

The purpose, the “why” is the motivation, e.g. to solve a problem, to gain insight in social behavior, to emergent phenomena or to establish top down measures for policy makers. This means if policy makers are in the focus, then top down influences on an aggregated level must be a part of the model. A recommendation is that one first step of modeling should be a reflection upon which modeling approach (e.g. as Multi-Agent Systems, System Dynamics or Discrete Event Simulation) suits the purpose and object best.

1.1. Multi-Paradigm Modeling need specialized tools

This chapter will briefly introduce several different specialized Modeling and Simulation Software tools enabling to use different modeling approaches within one model. What has a tool to have supporting modelers to build multi-paradigm models? Furthermore tools as Anylogic, Netlogo and MASGISmo (a platform mainly developed by the author at the AIT) will be discussed.

2. What are the advantages of combining approaches and what has to be worried about

Combining different approaches has a lot of advantages, but never the less technical as well as methodological difficulties arise in different ways. Such are different concepts of time, space and needs for model validation and verification. Some of these difficulties have to be solved in the very beginning of the model development. The paper discusses main obstacles that can occur and how they could be minimized.

3. Experiences from past Multi-Paradigm Simulation projects and lessons learned

Within the last few years we have used multi-paradigm simulation model for different purpose. One was in an EU project elaborating, A more sustainable development for the Dead Sea Basin, combining System Dynamics Modeling and Agent-based Simulation. Within another project called (MoZert) multi-paradigm modeling combines a linear optimization model, finding least cost Energy production measures, with agent-based modeling. This model analyses the feedback between household-agents, with their energy consumption, and the Energy system, which is determining the energy prices for the households influencing this energy consume.

4. The urbanAPI a multi-paradigm simulation project

The paper will devote a major part of it for the ongoing EU project called urbanAPI wherein an urban development model will be explored integrating agent-based modeling, GIS[1] modeling, 3D visualization and stakeholder involvement. The conceptual framework of the model will be presented and discussed how multi-paradigm modeling in this context can enhance the stakeholder involvement. We further assume thus to increase the acceptance by local habitants of expected impacts on their environment. This model will be developed for and applied in two different cities, Bologna and Sofia, in close cooperation with local authorities, urban planning departments and stakeholders. The stakeholder involvement will be used to parameterize the model and to reduce data gaps for the future development within different planning scenarios.

[1] Geographic Information Systems

5. Conclusion and Discussion

This chapter will resume what are the main improvements using a multi-paradigm simulation approach and which obstacles may occur. Furthermore how we assume that this combination of approaches will increase the simulation appropriateness supporting policy makers, finding the most valuable and accepted measures for urban development issues.

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International Cooperations: Cooperation with different, mainly European, project partners during several projects as CEMAGREF, IIASA, UNICATT, Frauenhofer Institute; ETH Zürich, University of Barcelona (IIIA), Forest Research Institute of Baden-Wuerttemberg, Slovenian Forestry Institute, and many others; Cooperation with research partners in Jordanien, Israel, Palestine, Romania, Germany, France, Greece as well as China and USA, beyond others.

He holds a Master's degree in Ecology and a Doctor's degree in Natural Science. He has about 10 years experience in modeling and simulation and has worked as a lector at the University Vienna for modeling and simulation, since 2007 he teaches at the „FH Technikum Wien“ and since 2010 at the University Graz. One of his special interests is multi-paradigmatic simulations, on which he also has elaborated his doctoral thesis. During his working experience at the AIT he also established emission projections for Austria and projects developing measures for mitigation of greenhouse gases for Austria. He was responsible for the development of the model integration within the Austrian Carbon Balance Project, a full carbon balance model for Austria. Under his lead a Java programmed multi-paradigm simulation platform, called MASGISmo, was developed, which has been successfully used in several national and international projects (provision:future.scape:mountain.scape project, EU-Dead Sea project). In the years 2007-2008 he had a scholarship to work at the „Universidad Autónoma de Barcelona“, at the artificial intelligence institute, in the theme of Agent-based modeling. Since 2009 he leads the project MoZert (Modellierung und Analyse der Wirkungen personenbezogener Zertifikatshandlesmechanismen auf Haushalte und Energiesystem).

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An Approach to Advance Urban System Modeling

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Abstract: *The aim of this contribution is to suggest an approach to advance urban system modeling. While the most established approaches of urban system modeling highlight feedback and relational characteristics, they do not include many other general system processes such as autopoiesis or phase transitions. This gap between knowledge applied in urban system modeling and knowledge available in general system research might give an idea about how much work an approximation of the two will require. Therefore, an incremental approximation of urban modeling to general system knowledge is suggested, which allows to work with improved models until comprehensive ones eventually become available. In relation to the selection of system processes with which to start such incremental approximation it is suggested to include those processes first, which are dominant in the city to be modeled. This knowledge can be acquired in a scoping study of the urban system prior to setting up the actual model. Following this approach, priorities can be set for the development of new components for advanced urban system models.*

Keywords: urban system; complex system; urban model; system dynamics; biocybernetic approach; agent based modeling

1. Introduction

With increasing global interdependencies our cities become more and more complex, challenging our attempts of understanding and intervention. Dynamic processes continuously reshape the fabrics of cities worldwide – be it emerging cities in Asia or cities of Central Europe in transition. This situation calls for comprehensive system models in order to facilitate the understanding of our cities, their reactions on external factors (e.g., climate change or macroeconomic crises) or intended interventions, as well as to inform decision makers in the urban context.

In this context, I attempt to contribute an approach to realize more comprehensive urban system modeling. Following a review of established urban system modeling approaches (sec. 1), this research paper outlines how to take the next step. A comprehensive list of general systems processes is compared with the system processes compromised in today's most common approaches of urban system modeling (sec. 2). It becomes clear that these approaches are not up to date with current research on general systems. Hence, urban systems modeling has to take the challenge and adopt the advances made in systems sciences, if urban scientists don't simply want to ignore them. Since the work remaining is tremendous, I suggest a stepwise approach in which more and more general systems processes are included in urban systems models[1] (sec. 3). Such a step by step approach allows for the application of improved models in the urban context while even better models are still being developed. In order to choose those system processes which will be included into improved, though not yet comprehensive, urban system models, I suggest to derive them from the actual urban system under investigation.

[1] This approach does not have to be unidirectional – general systems research might as well learn from urban systems research.

2. Situation and previous work

The field of urban system modeling is dominated by two types of modeling approaches: The one, the biocybernetic approach by Vester (1988), relates to and extends the system dynamics (SD) approach introduced by Forrester (1969). The other, agent based modeling, is rooted in the theory of complex adaptive systems (CAS), which was formulated by Holland (1975). Either approach has distinctive characteristics.

The biocybernetic approach makes use of system diagrams in which (directed, weighted) relations between elements of the system under consideration are depicted. It reaches beyond pure system dynamics in so far, as it introduces eight biocybernetic principles and seven domains of natural and man-made viable systems to assure wholeness in systems models. Insights about system properties are gained by analyzing the sensitivity of system elements and by simulating scenarios in which the impact strengths of selected elements are altered. Examples of application are given in, e.g., Vester (1980) and Cole (2003).[2]

Agent based approaches are centered around entities (the agents, e.g., persons, trees, cars) to which certain behavioral rules are attributed. Models simulate evolving spatial distributions of populations of agents, thereby providing insights into how agents' behaviors adapt or evolve while interacting with each other and showing how spatial organization of agents evolves. Examples of application are given in, e.g., Albeverio et al. (2007).

Both approaches are sometimes combined into a multi-methodology approach as shown by, e.g., Gebetsroither (2010).

3. Complication

Both established approaches used in urban system modeling – the biocybernetic approach as well as agent based approaches – only consider a fraction of general system processes known today, as listed by, e.g., Troncale (2011). Since both of the above introduced approaches are rooted in research of the 1960s and 1970s, they mainly highlight the then well-understood feedback and relational characteristics of system. Other findings which might apply to urban systems, such as autopoiesis (continuous renewal of a system out of itself) as well as criticality, tipping points, and innovation processes (leading to a transformation of the system) are not yet included. This leads to the situation that many of the general system processes compiled in the above-cited list are not considered by either of both approaches.

If cities are systems – a hypothesis on which this and much other research rests – then *any* general systems process might play a role in the city. As serious scientists, we either have to find out which processes are relevant in urban systems and which are not, or we need to consider all of them when designing urban system models.[3] Both approaches seem to imply a tremendous amount of work in studying the system properties of cities.

4. Solution

In order to swiftly provide improved urban system models to urban planners and decision makers, I suggest to follow the approach of determining the most relevant urban system processes first and include them one after another into environments of existing urban system models (SD and/or CAS). Following this approach, urban system models will not remain on the same level of development as of today until a comprehensive model will eventually be released, but instead will be improved incrementally. The choice of this approach should not, however, compromise the ultimate scientific goal of an as complete as possible understanding of the urban system.

[2] It is interesting to observe that many recent-years' applications of Vester's approach do not apply the biocybernetic principles and system domains, but only make use of the system diagram and its analysis.

[3] Consideration does not necessarily mean inclusion. A model might deliberately be simplified, taking only selected system processes into account. The approach of deliberate simplification, however, requires that the principal effects of the deliberately omitted are known. This is not the case for some of the ~50 system principles and the city as of today. In today's simplified models we don't know what we omit.

In order to operationalize this suggestion, I further suggest to carry out a scoping study for each city prior to the actual modeling. Such a scoping study can be either based on an analysis of literature or on field studies, and it could even include a participative setting in which citizens are involved. The result will be a list of system processes, which, as derived from the empirical scoping study, have been observed to play roles in the chosen city. A prioritization, ideally derived from the empirical research as well, will lead to the selection of the system processes to be included in the urban systems model. Hence, following this suggestion, priorities can be set for the development of new components for urban system models.

5. Conclusion and outlook

So far, I suggested an approach on how to make findings from general system research fruitful for urban systems modeling. Starting with the argument that existing modeling approaches cover only some of some 50 general system processes, I firstly suggested to combine existing urban system modeling approaches with models of other important urban system processes. Secondly, I suggested to carry out empirical studies prior to modeling in order to determine those system processes relevant in a specific city and, thus, to the model.

The suggested approach to advance urban system models opens new fields of research. The most prominent one might be the actual modeling of urban system processes other than those already represented in SD and CAS models.

The apparent long term goal in this branch of urban systems research is the understanding of the role each general systems process plays in the city as well as in future comprehensive modeling approaches for urban systems. This might eventually lead to a general systems theory of cities. In the near term, the research is targeted towards a better understanding of cities, thereby contributing to urban research and informing urban decision makers.

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Symposium L. Self-* Systems – Biological Foundations and Technological Applications

Part 1. Biologically and Socially Inspired Self-* Systems

Chairs: Vesna Sesum-Cavic, Institute of Computer Languages, Vienna University of Technology, Vienna, Austria, and Carlos Gershenson, Instituto de Investigaciones en Matemáticas y en Sistemas, Universidad Nacional Autónoma de México, Mexico City, Mexico

The increased complexity in today's' IT industry is one of the top problems and important obstacles. Self-organization appears as one promising way to cope with the increased complexity. Generally, self-* systems should posses as many self-* properties as possible (self-healing, self-tuning, self-learning,…) in order to achieve self-organization. Self-organization surrounds us. Many interesting self-mechanisms exist in our environment from which we can learn a lot. A careful observation of mechanisms in nature and society can discover some new tools that could beneficially be applied to different IT-problems. This conference track will focus on both biologically and socially based self-* systems. The papers could be theoretically based as well as with practical applications to important IT-problems.

Part 2. Self-Organizing Networked Systems

Chairs: Wilfried Elmenreich, Networked and Embedded Systems, Alpen-Adria-Universität Klagenfurt, Austria, and Carlos Gershenson, Instituto de Investigaciones en Matemáticas y en Sistemas, Universidad Nacional Autónoma de México, Mexico City, Mexico

A self-organizing system typically consists of many networked entities that organize themselves and cooperate through the exchange of information without the need of a centralized control instance but using a distributed approach. Information is exchanged locally among individual entities in the frame of the fulfillment of a certain global objective. Some simple and high-level rules in the individual entities lead to sophisticated functionality of the overall system. Many examples of successful distributed localized organization can be found in nature (e.g., ants, fireflies).

Self-organizing systems have various favorable properties:

- They typically adapt very easily to changes from inside and outside the system.
- Additional entities can be added and will be assimilated into the global system.
- Entities may be removed without too much affect on the global system, and other entities may take over crucial tasks of them.

Furthermore, self-organizing systems scale very well and there is no bottleneck of a central authority.

Research into self-organizing networked systems not only has technical and user-oriented aims, it also enables a high degree of interdisciplinarity.

We encounter self-organizing systems on an almost daily basis in:

- the formations of swarms of fish and migratory birds
- the interplay of termites when they build their hills
- the activity of body cells during the healing of wounds.

In many areas of nature, single individuals or organisms work together without central coordination, but in perfect harmony. Large areas of the economy have already been functioning for many years according to this paradigm.

It is the aim of this symposium to create a forum for exchanging ideas, discuss solutions and share experiences among researchers and developers of self-organizing systems applications.

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Von Neumann Redux: Revisiting the Self-referential Logic of Machine Reproduction Using the Avida World

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Abstract: *We introduce the distinctive, self-referential, logic of self-reproduction originally formulated by John von Neumann and present some initial results from a novel implementation of this abstract architecture, embedded within the Avida world. These show that, with this particular implementation, in this particular world, the von Neumann architecture proves to be evolutionarily unstable and degenerates, surprisingly easily, to a primitive, non-self-referential, "copying" or "template replication", mode of reproduction. We briefly discuss some implications, and sketch prospects for further investigation.*

Keywords: self-reference; self-reproduction; semantic closure; Avida; von Neumann; artificial life

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1. Introduction

As early as 1948, John von Neumann had already formulated and essentially resolved a fundamental paradox in the theory of the evolutionary growth of machine complexity: namely, how any (assumed or "divinely" created) seed machine can, directly or indirectly, give rise to machines arbitrarily more complex than itself (McMullin, 2000). Inspired by Turing's general purpose (programmable) computing machines, his resolution relied on a machine architecture comprising a general purpose programmable *constructor* which could act to decode a symbolic description of an arbitrarily (more) complex target machine and thus construct it. As a special case, this also led to a generic architecture for machine *self-reproduction* (where the description is now a *self*-description, and must be *copied* as well as *decoded*). This self-reproduction architecture, formulated very abstractly by von Neumann, was subsequently found to be strikingly reminiscent of the biological role of DNA (as "symbolic description") and of the molecular machinery of the "genetic code" whereby ribosomes (supported by tRNAs and other enzymes) decode or "translate" symbolic descriptions (presented as mRNAs) into arbitrarily complex protein molecules (and protein machinery).[1] More generally, von Neumann's architecture gave a concrete mechanical interpretation and implementation of the traditional biological idea that an organism can be decomposed into a set of tacit hereditary "factors" (genome) and a corresponding, manifest, functional, form (phenome). As subsequently emphasised by Pattee (1982), however, von Neumann's architecture (and its real-world biological counterparts) also carries with it an intriguing example of *self-reference:* the decoding relationship (the "genotype-phenotype mapping", in biological terms) implemented by the programmable constructor is also represented, in encoded

[1] The prescient nature of von Neumann's contribution is made clear from the fact that the chemical structure of DNA was not elucidated until 1953, and the programmable "decoding" or "translation" function of the ribosome was not fully formulated until 1960 (the code "proper" only later clarified as being implemented by the aminoacyl-tRNA synthetases).

form, within the symbolic description (genome) – and this encoding must be precisely according to, or at least consistent with, the very same mapping that the constructor itself (part of the phenome) implements. This most primitive and original form of *self-reference* has been dubbed "semantic closure" by Pattee, and has also been explicitly discussed by Hofstadter (1985); but the full implications of this self-referential closure for understanding, and fabricating, complex self-organising systems are, as yet, poorly understood. The present contribution presents a brief summary of one preliminary attempt to revisit and explore this issue afresh, through building and characterising abstract computational models in the *Avida* world.

2. Self-Referencing Reproduction and Evolution in the Avida World

Avida is an abstract ("simulated" or "virtual") world which has been extensively used to investigate very general properties of spontaneous evolutionary processes (Adami, 1997; Ofria & Wilke, 2004). It is loosely inspired by the structure of a conventional, large scale, cluster computer, with many separate computational nodes, each with one general purpose CPU and a limited local memory. The nodes are sparsely interconnected, typically in a regular two dimensional lattice.[2] The CPU instruction set is configurable on a system wide basis. It is normally reminiscent of a conventional microcontroller, but with some specialised features. A program running on a given node can overwrite the memory of a neighbouring node and in this way replace the program running on that node (effectively re-program the node). Based on this, a suitably designed program may be able to repeatedly reproduce itself into neighbouring nodes. Such a program is regarded as an abstraction of a biological organism. If an Avida world is initialised or seeded with a single instance of some such hand-designed organism, a population of organisms will grow to occupy the entire world roughly in the manner of bacteria in a petri dish. Certain CPU operations in Avida are made unreliable by design. This has the effect that mutant strains of organism can spontaneously arise, multiply, and compete in a darwinian manner for the finite available "space" (nodes) in the system. Unlike the petri dish analog, a culture of Avida organisms can be continuously replenished with "nutrients" (analogous to a continuous flow bioreactor) and thus the ongoing evolutionary process can, in principle, be continued indefinitely.

The "standard" mechanism whereby self-production is achieved in Avida is based on an approach pioneered in several predecessor systems, including *Coreworld* (Rasmussen, Knudsen, Feldberg, & Hindsholm, 1990) and *Tierra* (Ray, 1994). In effect, the parent organism simply inspects and copies its own program directly. We may classify this as reproduction by "self-inspection" or "self-copying". Such a mechanism is not possible for complex organisms in the real world for several practical reasons (McMullin, Taylor & von Kamp, 2001); but it is closely analogous to the more primitive template replication process underlying *in vitro* RNA evolution, and, indeed, to the DNA replication process that is one component of normal biological reproduction. In particular, it does support inheritable variation and evolutionary exploration of a combinatorially large (for practical purposes, infinite) space of distinct organism strains.

In contrast to this standard reproduction mechanism, used in all previous studies with Avida, we have designed a novel seed program, which incorporates the characteristic genotype-phenotype structure and self-referential genotype-phenotype mapping originally described by von Neumann. In the first instance the mapping has been simply modelled on the standard biological genetic code. That is, it is a sequential mapping from discrete "codon" symbols in the genome to functional "instructions" in the phenome, implemented via a lookup table located in the (parental) phenome (directly analogous to the functionality implemented by the aminoacyl-tRNA synthetases in RNA-

[2] The Avida world bears some superficial resemblances to von Neumann's own early formulation of an abstract cellular automaton (CA) world, particularly in its 2D network of discrete computational nodes. However, there are also fundamental differences. In the von Neumann CA, each node was a simple finite state automaton with no general purpose memory system (29 states per node, equivalent to less than 5-bits of special purpose memory); whereas each Avida node comprises a general purpose CPU and – by comparison – a substantial general purpose memory system, typically of capacity at least some hundreds or thousands of bits and potentially configurable to be much bigger.

protein translation). The lookup table is itself, self-referentially, encoded into the genome. While it would be expected that this self-referential mapping would be highly conserved (robust) in evolution, we nonetheless conjecture that some significant long term evolution (either selective or by drift) should be observed.

As yet, only preliminary experiments have been run and analysed with this novel self-referential seed organism. However, the consistent experience to date has been that instead of observing either simple conservation or long term evolution in the genotype-phenotype mapping we see relatively rapid degeneration of the entire reproduction mechanism – i.e., emergence of “conventional”, non-self-referential, self-copying organisms, comparable to the standard seed organisms. These organisms lack the decomposition into distinct genome and phenome components, lack any genotype-phenotype mapping process, and therefore also lack the characteristic von Neumann self-reference (or Pattee's semantic closure). Once such organisms emerge they are selectively favoured in this world (as they avoid the computational load of translation/decoding without incurring any immediate offsetting penalty). It follows that this degeneration is essentially irreversible.

3. Discussion and Future Prospects

As noted, it is not surprising that self-copiers should selectively displace self-referencing organisms in Avida; nor is it *very* surprising that there might be some available mutational pathways for such degenerative strains to appear, as the Avida world is specifically designed to make reproduction by self-copying extremely easy (it can be achieved with a program as short as 15 instructions under the default instruction set). However, what was surprising was that this degeneration could occur with just a single point mutation in our newly developed seed organism. Given that several aspects of the reproduction cycle need to be well co-ordinated for reproduction to succeed, we had not thought that a single mutation would be likely to already yield a viable self-copier. Further analysis is ongoing to fully understand the mechanism for this transition but it does reinforce the creative power of evolutionary search. More importantly, our next step will be to introduce specific mechanisms that will selectively favour self-referencing organisms over self-copiers (several potential mechanisms have already been identified). In this way, we should avoid the degenerative takeover by self-copiers and return to the our core research question which is to observe and characterise evolutionary change in the self-referencing genotype-phenotype mapping within a suitably configured Avida world.

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The Influence of Self-Organization on Reducing Complexity in Information Retrieval

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Abstract: Modern software systems suffer from increased complexity. Large software systems are composed of many components that are interlinked. The internal states of these systems contain a huge amount of information. The main obstacles lay in the lack of the reliability and robustness which lead to poor performance. New and advanced approaches are necessary to deal with complexity. A promising approach is the use of the self-organization concept. Self-mechanisms present in nature, social human behavior as well as business and economics serve as an inspiration to be mapped to different IT scenarios. As a proof-of-concept of self-organization mechanism in IT, a hybrid of reinforcement learning and genetic algorithm is proposed and is applied to the problem of information retrieval in the internet.

Keywords: reinforcement learning; intelligent agents; Internet search engines; genetic algorithm

1. Introduction

Observing our environment on macro scale or micro scale, we are surrounded by complex systems. These systems have a huge number of different states depending on environmental changes. In computer science, software systems are open systems evolving in a dynamic complex environment, designed as sets of interacting components, highly distributed both, conceptually and physically. Complex software systems are characterized by a huge number of heterogeneous, distributed, unreliable components as well as dynamic changes in the environment (Šešum-Cavic and Kühn, 2010).**Fehler! Verweisquelle konnte nicht gefunden werden.** New paradigms, mechanisms and techniques are needed, allowing these systems to autonomously manage their functioning and evolution.

This paper discusses examples of self-organization approaches in computer sciences and their application to reduce complexity in dynamic complex environments. As a proof-of-concept, one specific scenario is described and treated: the information retrieval from the internet. Internet technologies have had an explosive development during the recent years. The number of web search engines, trying to meet user's requests, is increasing. The approaches for the internet search realization can be roughly classified into two categories (Gudivada et al, 1997): index-based approach and links-based approach. Many internet search engines combine both aforementioned approaches. The dynamical nature of the web imposes the problem of efficient internet search. Intelligent agents containing genetic algorithms (GAs) are one way for the realization of such techniques (Chen et al, 1997; Šešum and Cvetković, 2002). The novelty of the scenario refers to the hybrid intelligent method applied for the first time to this problem.

2. Application Case: Hybrid Genetic Algorithm with Reinforcement Learning Technique

The intelligent agent that contains the genetic algorithm with adaptively changing parameters and reinforcement technique applied to the case study – optimization of information retrieval in internet. The entire web has a graph structure. In order to estimate the adaptation of some URLs in the population, it could be useful to consider the documents that the URL points to and to take their adaptation into account. In this implementation, the agent searches for the relevant information in the Internet. If certain information is found successfully, the agent will receive a certain amount of reward. In term of reinforcement learning, the agent will learn to maximize the reward it receives. Actually, the agent performs self-learning through this process. This is realized by value iteration (Sutton and Barto, 1998), modeled as:

$$f^{t+1}(h) = f^{0}(h) + \frac{\gamma}{L}\sum_{i=1}^{L} f^{t}(h_i)$$

where *f* is the fitness function calculated as the average value:

$$f(h) = \frac{1}{2}(f_{links}(h) + f_{index}(h))$$

$$f_{links}(h) = \frac{1}{N}\sum_{j=1}^{N} f_{links}(input_j, h)$$

$$f_{index}(h) = \frac{1}{N}\sum_{j=1}^{N} f_{index}(input_j, h)$$

N is the number of input documents, *L* is the total number of terms, *h* is a particular document whose adaptation is wanted to be estimated, *t* is the current number of iteration, h_i is the document that *h* links to, γ is the discount rate that determines the value of future rewards, $0 \le \gamma \le 1$. In order to estimate similarity between two documents, a well-known similarity measure - Jaccard's score is used as function *f*. This implementation performs a rank-based selection, crossover and different types of mutation (both selective and semantic). The determination of mutation rate depends on the type of mutation (selective, semantic).

3. Results

The described implementation is realized in a static domain (and can be further extended to a dynamic domain). The examinations included (Fig1.): GA search without Reinforcement Learning and GA search with Reinforcement Learning. The proposed method is compared to well-known Best First Search Algorithms (Pearl, 1984). Using this approach, the results are 121% better than the results obtained without using Reinforcement Learning technique.

Figure1. a) GA search without Reinforcement Learning; b) GA search with Reinforcement Learning.

4. Conclusion

The examples from the exact sciences as well as from social sciences show how self-organizing mechanisms help to solve complex situations and give an inspiration about how they can be mapped and reused in the applicative levels. As a proof-of-concept for the reuse of these mechanisms in computer science, the information retrieval in the Internet is treated. To optimize the process of information retrieval, a self-organizing hybrid approach that exhibits the properties of self-learning and self-adaptation is taken. We described an efficient way for solving this problem by using an intelligent agent that implements genetic algorithm with adaptively changing parameters and reinforcement learning technique. Preliminary test-examples for measuring the performance of the applied method are presented. From the results, it can be concluded that self-organization is a promising approach to deal successfully with dynamic changes in the environment.

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Coordination and Self-Organisation in Crisis Management

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Keywords: distributed systems; multi-layered management; crisis management

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In large-scale crises, the number of professionals involved from various organisations can range to hundreds. Handling a single crisis often involves interactions at multiple locations, both on-scene as off-scene, between which participants involved need to move. Besides the continuously ad-hoc construction and adaptation of organisations, the crisis situation itself can be highly dynamic. Improvisation is often required to handle unexpected events. Crisis management requires handling of continuously changing conditions while having incomplete information. The FP7 BRIDGE project[1] aims to facilitate such multi-agency collaboration in large-scale emergency relief efforts. The key issue explored in this paper is how to structure self-organisation, such that control can still be exerted, while enabling individual organisations and individuals to maintain autonomy and decide and act locally.

Exchange of information is required to enable coordination and decision-making in a crisis management-organisation. In other words information exchange is needed to enable self-organisation. One method of supporting information exchange is using hybrid crisis management systems encompassing both people and software agents, as, for example, used in projects as Combined Systems[2] (Storms, 2004), CIM (Abbink et al., 2004), and ICIS[3] (Ferro et al., 2007). These projects aimed to model systems such that all entities involved - humans, agents, information systems and sensors - are connected through multiple networks, together forming actor agent communities (Wijngaards et al., 2004).

However, crisis management involves a multiplicity of complex and (semi-) autonomous organisations that cooperate, requiring coordination and decision making at multiple levels. To exert control at different levels, while allowing for improvisation is a design challenge. Self-organisation needs to be structured, such that autonomy to improvise locally is retained, while dependencies and expectancies are kept clear throughout different levels in the organisation. The need for autonomy and ability to improvise requires a self-organisation mechanism that accommodates both bottom-up and top-down organisation and collaboration, permits deviations, failures, and even rule-breaking. At the same time, the self-organisation mechanism must be reliable, safe, and secure, but still capable of routing only relevant information to those who actually need it. An architecture is required that can be hybrid in combining locally distributed self-organisation with top-down organisation.

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[1] http://www.bridgeproject.eu

[2] http://combined.decis.nl/

[3] http://www.icis.decis.nl/

Within the BRIDGE project different complex heterogeneous organisations need to cooperate at different levels of authority and control. Each organisation forms its own Actor-Agent Community with its own resources and policies. The behaviour of the organisations needs to change frequently, due to the dynamics of crisis scenarios. A self-management architecture (Veelen & Splunter, 2008) is used to distribute autonomy of planning and control. The self-management architecture views organisations as layered systems, in which each layer has autonomy to act within the boundaries set by the layer above. Each layer has a local manager, depicted in Figure 1. The boundaries to act are expressed as objectives and agreements. These two elements specify the goals to reach, the degrees of freedom and indications of events in which synchronization with stakeholders is required.

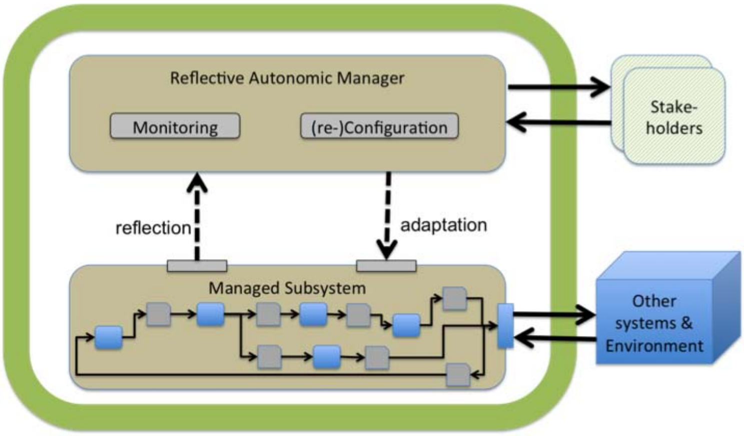

Figure 1: Generic Reflective Autonomous Architecture

Each layer executes workflows, and has a Reflective Autonomous Manager to perform self-management. A reflective autonomous manager performs monitoring and workflow generation and adaptation. Stakeholders set goals for the reflective autonomous manager, with respect to the required services and the desired quality of service. The reflective autonomous manager generates workflows to fulfil the set goals, using knowledge on the available resources within the level, and its knowledge on the available capabilities of the components within the managed subsystem. Each autonomous manager can use a separate workflow generation and adaptation approach, allowing the integration of multiple workflow approaches at different levels. Components in the managed subsystem can be other layers with their own reflective autonomous managers. When a reflective autonomous manager is unable to create a workflow fulfilling all of its set goals, the manager reports back to its stakeholders.

Defining the interaction between different layers, i.e. structuring the objectives and agreements between local managers, is our focus of research. Directive interactions between local managers are defining the expected behaviour and the space for improvisation. Escalating interactions are defining interaction patterns when local managers are unable to meet their expected behaviour within its given space for improvisation. Capturing the boundaries for both types of interactions in objectives and agreements is our research focus.

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Sander van Splunter

Sander van Splunter received his PhD in Computer Science at the VU University Amsterdam. After working as a researcher on complex adaptive systems, he moved to Delft University of Technology where he currently holds the position of Assistant Professor. His main research focus is to enable adaptation within dynamic complex systems. Systems are considered multi-layered, where each layer contains structures and processes, whose interactions results in complex behaviours. To enable local adaptations, knowledge needs to be made explicit and integrated in both structures and processes.

Bernard van Veelen

Bernard van Veelen is a senior researcher and program manager for Thales Research and Technology in the Netherlands (TRT-NL). His research focuses on artificial intelligence, autonomous software and enabling technologies for dynamic distributed systems, what he calls “intelligent autonomous middleware”. In 2005 he transferred to TRT-NL and is now a full time research engineer at the D-CIS Lab, working on quality of service management systems and secure, distributed data grids.

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Living in Living Cities

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Abstract: *This talk will give an overview of current and potential applications of living technology to urban problems. Living technology can be described as technology that exhibits the core features of living systems. These features can be useful to solve dynamic problems. In particular, urban problems concerning mobility, logistics, telecommunications, governance, safety, sustainability, and society and culture will be presented, while solutions involving living technology will be reviewed. A methodology for developing living technology will be mentioned, while self-organizing traffic lights will be used as a case study of the benefits of urban living technology. Finally, the usefulness of describing cities as living systems will be discussed.*

Keywords: cities; living technology; adaptation; self-organization; mobility

Acknowledgement: The full text can be found at http://arxiv.org/abs/1111.3659

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Carlos Gershenson is a full time researcher and head of the computer science department of the Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas at the Universidad Nacional Autónoma de México. He was a postdoctoral fellow at the New England Complex Systems Institute (2007-2008). He holds a PhD summa cum laude from the Vrije Universiteit Brussel, Belgium (2002-2007). His thesis was on “Design and Control of Self-organizing Systems”. He holds an MSc degree in Evolutionary and Adaptive Systems, from the University of Sussex (2001-2002), and a BEng degree in Computer Engineering from the Fundación Arturo Rosenblueth, México. (1996-2001). He studied five semesters of Philosophy at UNAM, México (1998-2001).

He has been an active researcher since 1997, working at the Chemistry Institute, UNAM, México, and a summer (1999) at the Weizmann Institute of Science, Israel. He has more than seventy scientific publications in books, journals, and conference proceedings. He has organized five international workshops/sessions and been part of more than forty program committees at international conferences and workshops. He has given more than ninety presentations at conferences and research group seminars. He has been reviewer for several journals, books, volumes, and organizations.

He has a wide variety of academic interests, including self-organizing systems, artificial life, evolution, complexity, cognition, artificial societies, and philosophy.

He is Editor-in-Chief of Complexity Digest (http://comdig.unam.mx), Book Review editor for the journal Artificial Life, and Complexity-at-large editor for the journal Complexity. He has worked doing systems consulting, software and web development, teaching at undergraduate and graduate levels, and scientific divulgation and journalism.

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Self-organizing Content Sharing at Social Events

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Abstract: *The number of photos and videos, shared by visitors of social events on web platforms, is increasing. However, if visitors are interested in the content of other visitors during the event, they have to wait a few days until content is available. If we enable visitors to connect to each other during the event a complex network evolves. A bio-inspired algorithm is the basis of our work and we investigate improvements of this algorithm by arguing that a small number of predefined tags can be exploited to reduce delivery delays and increase the hit rate.*

Keywords: user generated content; multimedia delivery; bio-inspired algorithm

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1. Introduction

Thousands of visitors follow social events, such as the royal wedding of Prince William and Catherine Middleton. Some of these users share their content produced during the event on YouTube, Flickr, etc., but mostly not immediately. If we connect the visitors' devices and enable the sharing of content immediately, a so called vision of the crowd emerges (del Fabro & Böszörmenyi, 2011). Visitors share with other visitors their most interesting content, thus one can see the event through the eyes of other visitors. However, such a system would result in a number of challenges. A network of visitors at social events can be considered as a complex network. It is full of dynamics, it is non-deterministic regarding user movement and behavior and a global state would be hard to observe. However, there are examples in nature and in computer science, where such complexity can be handled by adaptive and robust systems – see, e.g. gossip protocols that adapt the principles of epidemics. In current systems, e.g., (Kulkarni, Ganguly, Canright, & Deutsch, 2007) the researchers investigate search and transport as two different topics. An interesting point of their work is that the authors show that bio-inspired algorithms fit well the needs of search in dynamic networks. Our work is inspired by the endocrine system of higher mammals. Hormones are released to the blood stream and if reaching corresponding cells certain actions are triggered. The concentration of the hormones is managed by positive and negative feedback (Rushton, 2004). We want to point out that we do not want to create a model of the endocrine system, but we adapt the basic principles as described before to our needs. We have already introduced such an algorithm in (Sobe, Elmenreich, & Böszörmenyi, 2010). Hormones represent demand for content and are spread to the network. At the same time content is attracted by hormones and travels towards a higher hormone concentration. Thus, the algorithm combines search and transport. By exploiting the transport path for replication robustness is increased and the search space reduced (Sobe, Elmenreich, & Böszörmenyi, 2011). However, one important point is still missing. How do we react to emerging production and consumption patterns of users at such events? In this paper we investigate such patterns at social events and improve the algorithm according to that.

2. Content creation at social events

In order to investigate user behavior, we need to rely on existing systems. Therefore, the basis for our evaluations is metadata from Flickr and YouTube on different social events. We want to compare user uploads from two different popular social events (1) the royal wedding of Catherine Middleton and Prince William (2) the inauguration of President Obama.

Search Terms	Royal wedding william kate london	Inauguration obama oath
Date	2011/04/29	2009/01/20
Flickr res./used	7638/5798	1603/1346
YouTube res./used	1000/644	1000/916

Existing analysis such as done in (Cha, Kwak, Rodriguez, Ahn, & Moon, 2007) only focus on the complete content. We want to concentrate on how content is produced at social events, what tags are created and how long it takes until a user uploads the content to the online platforms (see the Table). We filter content that has been produced or uploaded before the actual event. For the YouTube result set one has to note that only 1,000 videos are returned.

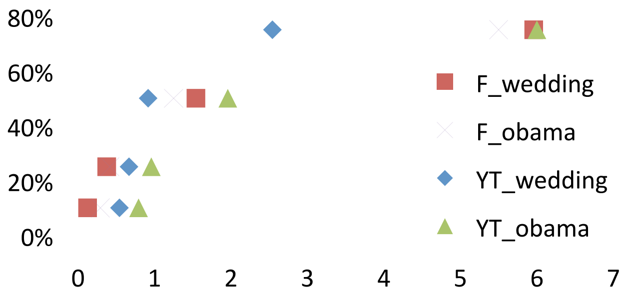

Figure 1 Upload time in days (F: Flickr, YT: YouTube)

The results in Figure 1 show the need for a live application, because only 25 % of the content is uploaded within the same day. For the rest, a visitor has to wait up to 300 days. YouTube videos are faster uploaded than Flickr images. We further analyze the different tags used for the content (**Fehler! Verweisquelle konnte nicht gefunden werden.**). Most content can be reached by the use of a small number of tags. We argue that some common tags might be predefined before the event and that a delivery algorithm can exploit this knowledge. E.g., if a user searches for "president" then it is likely that those images and videos tagged with "Obama" would also fit. The same applies for the combination of the tags "oath", "president" and "Obama". Even a hierarchy of tags can be exploited. E.g., if one requests "kiss" it is likely that a more general tag like "wedding" might also fit. However, if a too general term is used then all of the content might be returned.

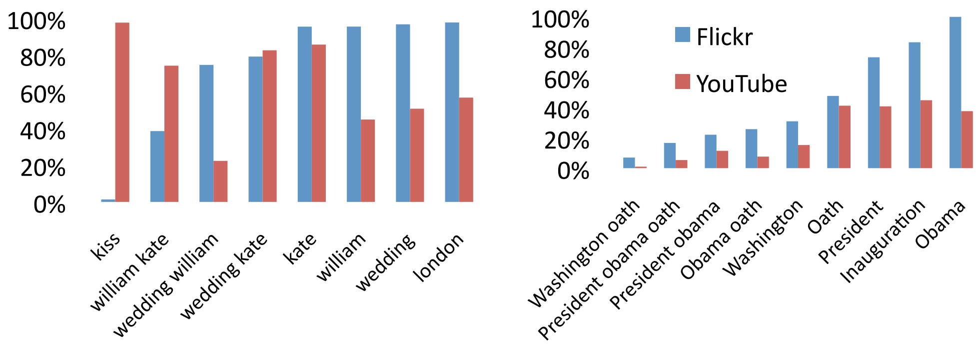

Figure 2 Tags wedding, inauguration

3. Hormone-based delivery

The basic idea is that content is attracted by corresponding hormones and for this a hormone path is needed from requester to content holder. To reach this, the requester creates hormones for the demanded file and forwards them. The hormones lead to actions when arriving on a node. If the corresponding content is available the node returns the content to the neighbor with the highest hormone concentration, otherwise it forwards hormones to its neighbors. The hormone forwarding mechanism is QoS-aware, i.e., the concentration forwarded to a neighbor is depending on its provided QoS (RTT, link availability, etc.). In previous work, we defined that one hormone type is created per file. If new content is added to the system, it takes some time until sufficient replicas are created to lead to low delays. It takes around 100 seconds until a critical number of replicas are created. During this time the delay is in the order of a few seconds. We thus want to reduce this startup delay by defining hierarchies of hormone types. We want to forward not only content that matches the requested tag, but also content that matches the tag one level higher, e.g., request for “Obama” also attracts content tagged with “President”. We assume that tag hierarchies are predefined.

4. Conclusion

The basis of our work is a bio-inspired algorithm that adapts the principles of the endocrine system of higher mammals. We showed that a dynamic network that could be built at a social event can take advantage of self-organizing delivery; however, if new content arrives it takes some time until sufficient replicas are created. To motivate our work we perform a short empirical study of user-generated content to show that pre-defined tags might help to efficiently and effectively distribute content during a social event.

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She received her Ph.D in January 2012 from Klagenfurt University. In her Ph.D. thesis she investigated delivery for non-sequential media access. For this she introduced a formalism to describe non-sequential media access and developed a bio-inspired algorithm to deliver non-sequential media and combined her findings to a middleware. Her current research focuses on bio-inspired algorithms for complex multimedia networks.

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Evolving a Team of Self-organizing UAVs to Address Spatial Coverage Problems

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Abstract: *We evolve controllers for a team of unmanned aerial vehicles (UAVs) with the task to observe or cover a partially obstructed area. The respective agents are limited in their sensory inputs to local observations of the environment without the ability to determine their absolute position or those of others. Each agent is equipped with a number of sensors that can detect the presence of other agents, an obstacle and the border of the area. The controller of an agent is implemented as an artificial neural network. The fitness for a given configuration is derived from the average spatial coverage over several simulation runs. The area coverage performance of the evolved controllers with different number of sensors is compared to reference movement models like random walk, random direction, and an algorithm based on the belief of the intention of agents met during the execution of the simulation. Our results show that evolved controllers can create a self-organizing cooperating team of agents that exploit the advantages provided by their sensors and outperform naïve coverage algorithms and also reach the performance of a recent algorithm that is using additional information as well.*

Keywords: UAV; self-organization; multi-agent systems; evolutionary algorithms; neural networks

Acknowledgement: This work was supported by the Austrian Science Promotion Fund (FFG) under Project EVOSOS and by the European Regional Development Fund and the Carinthian Economic Promotion Fund (KWF) within the Lakeside Labs projects MESON and cDrones.

1. Introduction

The problem of covering a given area with one or more mobile agents has many applications such as vacuum cleaning, exploration and mobile surveillance. If multiple agents and uncertainty regarding the environment and sensors are involved, finding a solution becomes non-trivial. A self-organizing approach for the coordination of such mobile agents promises small, cost-efficient solutions fitting possible target systems like autonomous mobile vehicles equipped with a few sensors, such as ground robots or unmanned aerial vehicles (UAVs).

Many existing solutions require external control, explicit communication, localization, and/or map building to solve a coverage task. In contrast, to reduce implementation complexity we are aiming at simple distributed approaches supporting general hardware that are robust enough in the event of a failure of a few agents.

In this paper, we present simple control algorithms for unmanned aerial vehicles in order to cooperatively achieve maximum coverage of a partially obstructed area under certain constraints like limited time (minimum time-to-complete) and minimum energy (with minimum number of turns) (Choset, 2001). The area to be covered is modeled as a time-discrete and space-discrete lattice of obstacles and free space. The control algorithm is modeled as a neural network and programmed via an evolutionary algorithm. The evolutionary design approach has the advantage of automatically exploring a vast number of solutions including configurations which appear to be counterintuitive (Elmenreich, 2008).

2. Problem Statement

We introduce a time-discrete, value-discrete model of agents, obstacles and free space area. The discrete model is a strong abstraction from real applications, but allows for a precise comparison to previous work on discrete-space coverage algorithms (Yanmaz, 2010) and simplifies reproducing the results of our model. The area to be covered is modeled as a finite two-dimensional lattice where each cell can contain at most one agent or obstacle. In each time step, an agent is allowed to move to one of the four directly neighboring cells given that the target cell is within the lattice and is neither occupied by another agent nor an obstacle. Figure 1 depicts an example with 5 agents in an 8x8 area.

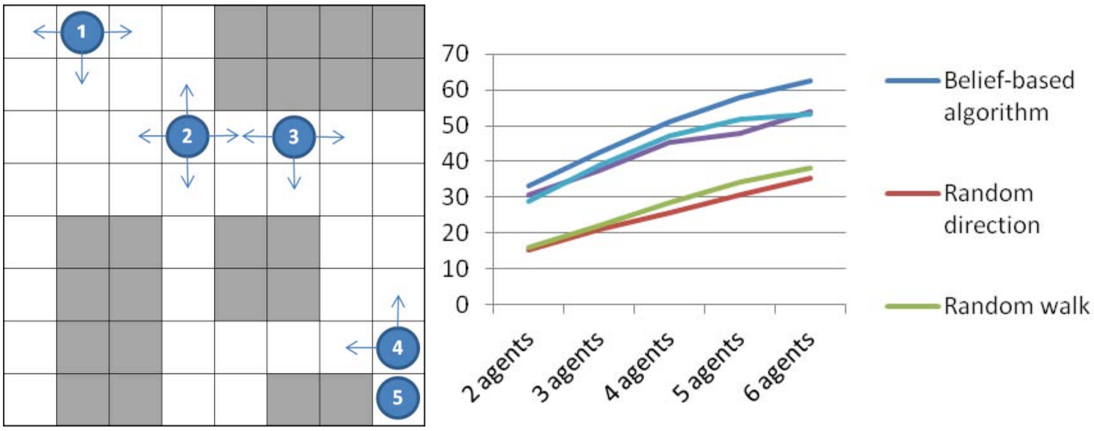

Figure 1: Example with occluded areas (shaded) and five agents and performance curves for different approaches

The goal of the agents is to have each non-occluded cell visited by at least one agent in minimum time. This problem is similar to the Traveling Salesman Problem (TSP) (Applegate, 2006), but the initial position of the agents, the position and shape of the obstacles, and the size of the lattice are initially unknown in our case. Therefore, a TSP solver or other *a priori* search approaches cannot be applied. Instead the agents need to learn to efficiently explore the area. Furthermore, we assume that the agents have limited computational capacities regarding map building and position estimation.

The completeness of the given goal is measured by two performance metrics, the *spatial coverage* (number of cells visited at least once divided by the total number of unobstructed cells) and the *completion time* (number of simulation steps needed). Therefore, the spatial coverage is defined as a value between 0 and 1, or 0% and 100%, respectively. In case the agents manage to fully cover the unobstructed area before the time expires, the completion time is used as an additional metric. These performance metrics are not normalized to the number of agents, thus a larger number of agents is expected to achieve better spatial coverage and shorter completion time. The performance will converge, when the number of agents is higher than a threshold.

3. Agent Controller Models

In order to exploit possible cooperation among the agents an adaptive controller is needed. In this work, we use artificial neural networks (ANNs) to control each aerial robot throughout the simulation of each map. ANNs are very versatile and can encapsulate a generalized solution for the given problem domain. During a simulation, each agent has its own instance of a time-discrete ANN with the same structure and properties. In general, ANNs possess very limited memory regarding previous states; therefore we apply fully-connected, recurrent networks with only one hidden layer with 4 neurons.

Training of the networks is done using an evolutionary algorithm, since we deal with belated rewards we get after a simulation of many executions of the revised ANN. We use the open-source FREVO framework to model our simulation environment and evolve the agent controllers with the built-in *nnga*[1] module. The algorithm is explained in more detail in (Fehervari, 2010).

The performance of the evolved controllers is compared to the following reference models: random walk (agent decides randomly in each step), random direction (agent changes direction randomly when occlusion would occur) and a recent belief based algorithm (Yanmaz, 2010).

4. Results and Discussion

For the evaluation, we use three test scenarios of 40x40 cells, one without obstacles, one with 10 % of the area covered with obstacles and one with 20 % covered area. The maximum time was set to 400 ticks. We never reach full coverage in any simulation run, thus the completion time did not play a role as performance metric for this setup. The numbers in Figure 1 are thus obtained by the average spatial coverage in % over 100 evaluations for each respective combination of number of agents, algorithm, and scenario. The results show that in general more agents achieve higher coverage, as expected. Moreover, the evolved cooperative agents achieve higher coverage than non-cooperative ones (non-cooperative agents cannot distinguish a neighboring obstacle from a neighboring agent). This means that the cooperative agents learned to actually cooperate in a way to improve the coverage task. In comparison to the reference algorithms, the evolved algorithms achieve always better performance than the random walk approach. However the belief-based algorithm shows better performance, due to the implied information exchange among the UAVs.

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[1] http://frevotool.tk

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Symposium N. Complexity and Management: from the Concept of Innovation to Social Responsibility

Chairs: Matjaz Mulej and Zdenka Zenko, Faculty of Economics and Business, University of Maribor, Slovenia, Gerald Steiner, Institute for Systems Science, Innovation and Sustainability Research, University of Graz, Graz, Austria, and Weatherhead Center for International Affairs, Harvard University, Cambridge, MA, USA, Filippina Risopoulos and Elvis Kenik, Institute for Systems Science, Innovation and Sustainability Research, University of Graz, Austria, and Stuart Umpleby, School of Business, The George Washington University, Washington, DC, USA

The current global crisis shows that systemic, i.e. requisitely holistic, management has been lacking due to one-sided (rather than cooperative inter- and trans-disciplinary) approaches and education of decisive persons. Implementation of stakeholders (rather than shareholders) concept is still a crucial open issue in creative/innovation processes. Most inventions do not solve the crucial non-technological problems; because of that also the highly innovative countries are in trouble, because their approach to innovation has also been one-sided, i.e. reduced to technological innovation and leaving the crucial non-technological innovations aside. Additionally, the innovations are often oriented towards solving problems on a short-term and connected to the product/service profitability. For about a decade progressive companies, the United Nations, and the European Union have been trying to overcome this crucial problem by various initiatives, e.g. by launching policy documents on social responsibility as one possible solution. In November 2010 the ISO –International standardization organization – made a crucial step forward toward systemic behavior. In ISO 26000 on social responsibility the interlinking concepts are (1) interdependence and (2) a holistic approach. Crucial details remain to be elaborated. This might be (also) our task. Rare engineering schools teach innovation management, and even rarer are schools teaching non-technological innovation management, very exceptional are the ones linking innovation management with systemic thinking in their courses. What can/will you contribute?

Matjaz Mulej, Zdenka Ženko, Vojko Potocan & Anita Hrast: *ISO 26000 on Social Responsibility Supports Solving the Global Socio-economic Crisis*

Vladimir I. Arshinov & Vadim V. Chekletsov: *Internet of Things Concept for a Social Responsibility*

Igor Perko: *The Business Intelligence Users*

Helena Knyazeva: *Innovative Complexity – Emergence, Self-Organization and Risk Management*

José María Díaz Nafría: *On the Foundations of Emergence – From Pre-geometry to Human Life by Using a Generalized Understanding of Information*

Maria Nesterova: *Systemic Approach in the Modern Management*

Zdenka Ženko & Matjaž Mulej: *Complexity and Management of Inventions to Innovations*

Helmut Karl Loeckenhoff: *Managing Complexity by Innovation*

Andrej Smogavc Cestar: *The Importance of a Management System for Social Responsible Pre-school Institutions*

Simona Šarotar Žižek, Matjaž Mulej, Borut Milfelner, Tadej Breg & Amna Potočnik*: Social Responsibility in Slovenia*

Ineza Gagnidze & Nana Maisuradze: *International Educational and Scientific Links of Georgia – the Shortest Way for Innovative Development*

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ISO 26000 on Social Responsibility Supports Solving the Global Socio-economic Crisis[1]

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Abstract: *The current global socio-economic crisis differs from all so far. It results from the neo-liberal economic model that has created, in one-sided economic statistics' terms, very much, but it also ruined much, even much more. By abusing the free market concept it created too many monopolies and too little satisfaction of humans to be able to offer a new way out from this crisis globally: `growth at any price has a too high price.´ Alternatives are still searched for. We see an option in the synergy of a combined application of findings in the following books on the best practices. Their common denominator lies in informal systemic, i.e. requisitely holistic, behavior that is backed by ethics of interdependence. This common denominator is expressed in ISO 26000 on social responsibility and supported by European Union´s 2011 action document on social responsibility.*

Keywords: innovation; neo-liberalism; requisite holism; social responsibility

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Internet of Things Concept for a Social Responsibility

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Abstract: *The paper deals with implementation of Internet of Things (IoT) concept for development of Social Responsibility. IoT as pan-communication technology can to increase persons and group awareness, to change modus operandi with serious pervasive games. Furthermore, IoT have great potential to manage complexity by re (constructing) systems for a functioning largely without human intervention.*

Keywords: social Responsibility; Internet of Things; complexity; smart environments; serious games; pervasive games; hybrid reality

Acknowledgement: This research project would not have been possible without the support of Russian Academy of Sciences and Russian Foundation for the Humanities.

Individuals' ability to active social response depends on various circumstances of person's internal and external world (umwelt, mitwelt, eigenwelt). From complex spectrum of these influences we'll consider A. human awareness, opportunities for relevant data, information and knowledge acquisition (afferent streams); B. Modus operandi forming (efferent streams), which we'll examine in terms of new pan-communication technologies.

The Internet of Things (IoT) ontological shift arises from several trends:

1. Artifacts acquire memory (RFID…);
2. Artifacts acquire sensing (Wireless Sensor Networks…);
3. Artifacts acquire thinking (Ubiquitous, pervasive computing…);
4. Artifacts acquire communication with persons, systems and each other (WiFi, Mobile Internet, RFID, Augmented Reality, Sensors, GPS…).

The Internet of Things project declare our new possibility to (inter)connect «6A»- Anyone, Anything, Anytime, Any place, Any service, Any network.

So the Internet of Things (IoT) concept is a vision in which persons, groups, objects, systems etc. will be strongly connected, and it touches profoundly all aspects of society. To reflect on such a vast subject, it must be broken down in different layers: a value chain, a service an application layer, the smart city concept and a global layer. The first layer affects industry and end-users, the second affects individuals and business models, the third affects planning and infrastructure, the fourth affects how decision making processes and resources will be divided on the planet.

“When objects can both sense the environment and communicate, they become tools for understanding complexity and responding to it swiftly. What’s revolutionary in all this is that these physical information systems are now beginning to be deployed, and some of them even work largely without human intervention.” (Chui, 2010).

Internet of Things (IoT) could be defined as a dynamic global network infrastructure with self configuring capabilities based on standard and interoperable communication protocols where physical and virtual ‘things’ have identities, physical attributes, and virtual personalities and use intelligent interfaces, and are seamlessly integrated into the information network. (Sundmaeker, 2010).

The social responsibility level depends on very complex interconnections and inter-representations (Portugali, 2002) of material, energy, psychological, intersubjective and other dimensions of our hybrid Actor–Network (Latour, 2005) Environments. Some crucial elements of such a system can be improved in Social Responsibility context by IoT tools and other instruments of hybrid reality and pan-communication technologies. For example:

- Increase of persons and groups awareness through transparency of «online» information, relating to our lifeworld (accessibility of neibourghood sensor networks data streams…), visualization of concrete individual actions system effects…;

- Modus operandi changing by thematic serious games, including pervasive (Montola, 2007) city games on real landscapes with RFID, AR, Sensors, Self-Tracking etc. usage.

How to implement our new abilities to distant perception, interaction, communication with artifacts and other persons by web of things, wireless body area networks (WBAN) etc.? How to create rich participatory, personalized, actually Alive and Smart Environments? - We can construct certain layer of city landscape reality, representing certain mode of our corporeality. In other words a social space becomes literally a body of Other. Such interactive area we call Geo Sapiens. In a sense of Geo Sapiens, Michel **Foucault’s** Technologies of the Self lead to public spaces specific design approach. In these systems more strong recursions of emergent interfaces (body/ consciousness/web/environment/other/body…) deepen individuals understanding of interdependence and social responsibility holism.

In our presentation we’ll try to explicit these thesis’s and to compare few scenarios of Geo Sapiens future vision. We actually want our cities to become more tender and sensitive.

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The Business Intelligence Users

How to generate the value added for the managers

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Abstract: *The business intelligence (BI) can provide a high added value for the business users, supporting their management functions. Major research and development efforts are being put to create technology for the information delivery, sometimes putting aside the purpose of the reports and ignoring the assessment of value added of the BI system. In the presented paper the examples of applied BI reports are examined, clarifying the purpose, business value added, data properties, and business issues, connected with the use of BI reports. In the analysis two types of BI reports are involved: reports for measuring the present business performance, and reports for predicting potential business results. First the purpose and value added are examined for multiple user roles: top managers, regulators, executives and regular business users, focusing on the relation between the reporter and the controller. To provide the full picture, the evaluated business value is compared with the issues that need to be mastered to actually produce the results.*

Keywords: business intelligence; predictive analytics; value added; management support; controlling

1. Introduction

The business intelligence systems provide continuous informational support for the management processes (Liebowitz, 2009), enabling the creation of complex business reports. These business reports comprise multiple views on the enterprise performance, providing a complete picture of the current business performance and trends. The most powerful tools used for the performance monitoring are the information integration (Cancer, Vrečko, Hauc, & Perko, 2009) and the visualization technologies (Zhu & Chen, 2005). The advocated BI system's capacity of providing comprehensive predictions is still applied as a separate tool (Bose, 2009).

The business users analyse BI reports to achieve their business goals. Discussing the business users needs and discovering the purpose of the particular BI report enables us to upgrade the content to actually achieve the business goals (Williams & Williams, 2007). The BI reports are always – or should be – analysed by two business users: the reporter and the controller. The report contents and form is dependent on who ordered and supervised the report creation.

One of the main issues in BI is how to integrate large quantities of scattered business data. BI developers face issues concerned the data availability, data size, complexity and other quality issues. The need for quality data is increasing with the business users expectations and the BI tools used. Not all BI reports require the same data properties. Most detailed and integrated data is demanded from the regulators, while the predictive analytics posts a new level of data quality demands.

The proper use of visualisation can provide insight into the otherwise unrecognisable data. It is though hard to select the proper visualization to support the business user (Lengler & Eppler, 2011). In general it stands: the higher the level of data complexity, the higher the need for visualisation. The main current topic is the visualisation interactivity and the ability to combine loosely related data. For instance: how to present predictive analysis results in correlation with the existing data?

The predictive analytics (PA) is currently used in multiple fields, among them actuarial science, financial services, insurance, telecommunications, retail, travel, healthcare, pharmaceuticals (Wikipedia, 2011). The PA is usually used to create a unique prediction model and interpreting the models results only once. The question arises: how to include PA in BI continuous informational support for the management processes (Bose, 2009)?

In the paper first a simple overview of the technologies involved is presented, opening the discussion on the main characteristics of the transactional IS, Business intelligence reporting systems and predictive analytics. The questions on purpose, business users, issues and business value added are discussed on five examples of BI reports, providing the insight to the actual use of BI systems, value added and issues, concerning the creation of BI reports.

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Innovative Complexity

Emergence, Self-Organization and Risk Management

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Abstract: *Complexity is the most popular and widely circulated concept nowadays that represents the whole research field of complex systems evolution, their instability and meta-stability, transformation (integration or decay), adaptation, links with environment (enaction), cyclic development, etc. Complexity is closely connected with non-linearity, instability, evolutionary holism, emergence, innovations and innovative development, self-organized criticality and risk management. The modern theory of complex adaptive systems allows asserting that properties of complex systems and of its medium determine each other. Complexity, emergence, self-organization, activity are their mutual properties which appear in their interaction. A system is determined by a medium and builds its own medium which, in its turn, exerts an influence upon the system and constructs it. It is impossible to innovate a system, if its medium isn't subjected by changes, and vice versa.*

Keywords: complexity; innovation; non-linearity; emergence; self-organization; active innovation media; management; risk management; ecology of action

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1. Innovative Complexity

In the context of problem under discussion, the most important notion is the notion of innovative complexity. Both a system and its medium possess complexity. The content of notion of innovative complexity can be exposed by the concepts of non-linearity, instability, wholeness, self-organization and emergence.

Every complex system possesses the following characteristic properties or features.

1) Complexity is a *multitude of elements* of a system connected by non-trivial, original bonds with each other. Complexity is a dynamic net of elements (elements are connected according to certain rules).

2) Complexity is inner *diversity* of a system, diversity of its elements or subsystems that makes it flexible, able to change its behavior depending on the changing situation.

3) Complexity is a *multi-leveled organization* of a system (there exists architecture of complexity). A complex system is more than sum of its parts of any size; therefore it should be analyzed in terms of a hierarchy of interactions. At the same time, a part may be more complex than the whole as well (for example, a human is more complex than society): a part can be a carrier of all system properties and simultaneously can possess super complex own regimes of functioning and of development.

4) Complex system is an *ope*n system, i.e. it exchanges matter, energy and/or information with environment. It is hard to determine boundaries of a complex system (vision of its boundaries depends on the position of an observer).

5) Complex system is such a system which demonstrates *emergent phenomena* (events, properties). We name emergent such unexpected properties which appear at the dynamic level of the system as a whole and cannot be deduce from the analysis of behavior of separate elements. But a thing (an object or a system) which becomes a part of the whole can be transformed and manifest emergent properties as well.

6) Complex system has *memory;* the phenomenon of hysteresis is characteristic for it. When changing the regime of its functioning, the processes recommence along the old tracks (former riverbeds).

7) Complex systems are regulated by loops of *feedback*: negative feedback which ensures restoration of equilibrium, the return to the former state, and positive feedback which is responsible for fast, self-urging growth, in the course of which complexity blossoms.

Complex system is such a system whose functions are much more complex than its structure. In order to be effective, the controlling influence over it must be not less complex than the very system under control. Another important property is fragility of complex system. The more complex it is, the more unstable it becomes. A governing influence which is conceived to improve or enhance its organization can destroy it. One says that complex systems poise at the edge of chaos. Their behavior is described by the theory of self-organized criticality.

Complex systems are operationally (or organizationally) closed ones. The increase of complexity is increase of degree of their selectivity (in their interaction with environment, in perception and action, in creative work, etc.).

2. Emergence and Self-organization

The concept of innovative complexity is connected with the notion of emergent properties of systems, which appear in the course of their evolution. Emergence should not be understood in a simplified way: it is not just unpredictability of appearance of new properties. When we speak of unpredictability and incomprehensibility of appearance of something new, we lay stress only on the epistemological aspect of novelty. Emergence, along with the creative chance, is rooted in being, has an ontological basis. When one says that the new appears spontaneously, is absolutely undetermined, one emphasizes the ontological aspect. Besides, emergence is irreducibility of properties of the whole (system) to properties of parts (elements or subsystems) as well as irreducibility of a more organized to a less organized, complex to a more simple, higher level of hierarchy to lower one. Evolution takes place by leaps; at the each turn of evolution, new leaders appear. In other words, phase transitions, emergent transformations occur in the course of evolution; and new, unknown properties are created by such transformations. Emergence is a way of birth of novelty in the process of evolution of nature and society.

3. Active Media of Innovations

Complex structures are built on an active medium (plasma medium of Sun, active medium of neurons of a brain, activities of inhabitants or enterprises in a city, etc.). A new conception which comes from cognitive science is conception of enaction, i.e. in-building of a complex system into a medium due its own activity. Complex system changes, transforms itself and gets renewed in interaction with its medium and from it, the system builds for itself its own medium, its environment (Umwelt) which, in its turn, exerts influence upon it and determines it. The system and its medium are connected by loops of nonlinear feedbacks, in fact they determine each other, and i.e. they are in relationship of co-determination, use mutually given possibilities, awake each other, come into being in a mutually dependent way, are co-created, change in interaction and due to it.

The mutual activity of a system and its medium and the concordant and mutually dependent emergence of new properties both in the system and in its medium can be called co-emergence. J.H.Holland proposes to call this phenomenon *echoing emergence*.

4. Innovations and Risk Management

Risks and failures of innovations is an inevitable component of the innovation process. The innovation process is always accompanied by risks. Nobody can guarantee that a certain innovation will surely get accustomed in nature or will be widespread in society. The negative experience in creation and introduction of social innovations is not of less significance than positive one. The influence of failure in innovation activity of some organization or company goes far out of the loss of its capital investment. The failure of innovation process can be accompanied by the loss of the moral spirit of staff, by the increase of mood of negativism and by stronger resistant to innovation in the future.

Innovations can be decelerated or even fail because of difficulties with financing, lack of corresponding skills and mastery, discrepancy to current tasks and aims of activity. The flexibility of strategies and the ability to efficient adjustment of purposes should be included in the innovation activities.

The French philosopher and sociologist Edgar Morin has developed an important notion of *ecology of action*. Uncertainty is inherently inserted into the very notion of complexity of the world. Uncertainty means incompleteness of any process of cognitive and practical activity, openness and nonlinearity of outcome of this activity. Any action undertaken by us is determined by conditions of natural and/or social environment, and it turns out that it can deviate from a direction which has been originally given to it. According to Morin's words, "we cannot be sure that the result of action will correspond to our intentions, on the contrary, we can seriously have doubt about it".

We have to refuse the habitual linear scheme an *undertaken action → a received result,* and to admit the nonlinearity of any action, to be more precise, the nonlinearity of connection between the action and its result (consequences). As soon as an individual undertakes an action, whatever it would be, the action begins to elude his intentions. This action joins the universe of interactions and is finally absorbed by environment so that, as a result, we can get even something opposite to our primary intention. Often an action comes back to us as a boomerang. Therefore, a social innovation or innovation influence upon society can have, according to Morin, three types of unforeseen consequences, namely: 1) a perverted pernicious result is more important than a favorable result on which hopes were set); 2) the futility of innovation (the more changes are made, to a more extend everything remains as before); 3) progress which runs the danger (we wanted to improve society, but as a result we managed to suppress liberty and abolish the system of security).

The first consequence of innovation signifies that the negative experience is also experience which is not less important than positive one, when we managed to do everything. The second possible consequence – from the point of view of the theory of complexity – signifies that our managerial influences didn't correspond to the own properties (structures) of a social medium or they are lower than the threshold of its sensitivity. The third mentioned consequence indicates in fact that the managerial influence was non-resonance for social medium.

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On the Foundations of Emergence

From Pre-geometry to Human Life by Using a Generalized Understanding of Information

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Abstract: *It is the purpose of this contribution arguing that emergence, on the one hand, exists as something new in nature; on the other hand, that it is something transcending classical computation. To this end, it is suggested a careful generalization of the concept of agency, proposed by Stuart Kauffman as system able to perform at least one thermodynamic work cycle, throughout all the levels of complexity – from pre-geometry to social contexts –. We set off from the level of pre-geometry (described in terms of spin networks in the sense of Roger Penrose) leading up to social systems. At this higher level, we deal with agents who have self-reflection and try to reconstruct objects and situations from essentially limited information. To that purpose hermeneutical agency is introduced, in which the cycles defined by observation-representation can be seen in thermodynamic terms, and is the goal for such agent the reduction of the complexity of the related representation, generally linked to some pragmatic situation. At this level, innovation can be visualized, in the best case, as emergence in social contexts. But in order to move throughout all the latter of complexity, we propose as unifying principle that the pair energy-matter can be regarded alongside the pair information-structure (representing such bipolarity the difference and relation between potentiality and actuality). Whereas energy is conceptualized as potentiality to perform work (change), we claim that information can be visualized – from the outset – as potentiality to utilize such work in benefit of the organization of the system, being structure the actualization of such organization potential represented by information. Since the beneficial use of work is fundamental for defining agency, this general understanding of information facilitate the task of properly extending the concept of agency to the whole hierarchy of complexity and to visualize agents as playing natural games at the different levels. Using such viewpoint we shall map, on the one hand, agency dynamics through game theoretical applications; on the other hand, evolutionary system dynamics through mathematical category theory.*

Keywords: emergence; evolutionary computation; pre-geometry; hierarchy of complexity; information; agency

Does emergence exists as something new in nature? As we have argued in several publications (Zimmermann and Díaz 2012a, 2012b; Díaz & Zimmermann, 2012), emergence can be understood as the “real” consequence of agents’ actions on its own level –extending the idea of minimal autonomous agency elaborated by Kauffman (2000-2006) as a system capable to perform thermodynamic cycles. This point of view allows us to speak of emergence as something ontologically irreducible to the parts constituting the agent. Since we are speaking of emergence in nature – in a general sense –, this requires a careful review of what is understood by agency throughout the different levels of complexity: from pre-geometry, to physics, to chemistry, to biology, to conscious life and to sociality. The consequences of this alleged agency – if they are really becoming something new – must be ontologically irreducible to the effects of the involved parts – regarded by themselves – and fundamentally dependent on the attained rules of interaction, i.e. to its organization (the “new order of existence with its special laws of behavior”, using S. Alexander’s expression (1920)). The problem is how to define the organizational means allowing on the one hand the agency on its own level; on the other hand, the constitution of new levels, which can be seen as both emergence of new agency and formation of new classicity (Zimmermann, 2000). Such vision brings to the fore – considering the conditions for attributing agency and classicity – the need to derive the philosophical concepts of choice, meaning and normalization from the fundamental level of physicality and traced back to social contexts. Similarly a big picture of the roles ascribed to the fundamental attributes of energy, matter, information and structure should be reviewed in order to overarch throughout the hierarchy of complexity within the universe as a fundamental and global system.

If aiming at computationally modeling emergence, we argue that emergence is something transcending classical models of computation, thus new computational approaches have to be achieved to visualize emergence as a result of a more sophisticated understanding of computation. Whereas classical computation is restricted within the limits of Turing's halting theorem or Gödel incompleteness, ontological emergence –as a consequence of its irreductibility– might be understood as the need to overcome the limitations of a given algorithmic closure referred to the relations governing the system, which can be in turn mapped to a Turing machine. Thus, the question can be redirected to what kind of computational model might represent a real case of emergence. Several candidates as quantum computation (), cellular automata (Wolfram, 2002), computational ecologies (Mainzer, 2004), etc. provide practical means to overcome classical limitations offering and, at the same time, models for mapping the computational sense of emergence in reality. In the human, the problems of perception, scientific discovery, etc. require creative abductions which represent a most distant case of classical computation as discussed elsewhere (Díaz, 2011). Though these abductions could be regarded as epistemological emergences, since they actually occur in ontological closure – as proved by the author (2011b; 2011c) –, they represent indeed relevant cases of genuine emergence. Furthermore, by unfolding our viewpoint we shall also ask: How can we rephrase the relationship between physics, aesthetics, and ethics as visualized under the human perspective, in order to actually develop new, relevant viewpoints and practical applications derived therefrom?

1. Preliminary hypothesis

As stated above, we rephrase the quest on the nature of emergence to the proper understanding of agency throughout the hierarchy of complexity. To this purpose,

(1) An autonomous agent – following Stuart Kauffman (2000-2006) – is to be understood in a generalized sense as a system able to perform thermodynamic work cycles – or more specifically, able to achieve a new closure in a given space of catalytic and work tasks propagating work out of non-equilibrium states and playing natural games according to the constraints of their environment.

(2) Since we aim at developing a global picture in which the universe is understood as a global system, we cannot start from the fragmented vision of quantum vs. relativistic physics. To this end, we set off from the level of pre-geometry (described in terms of spin networks in the sense of Roger Penrose and considering the related developments in quantum gravity) leading up to social systems. At the fundamental level, the approach provided by Louis Kauffman´s knot theory offers a candidate to visualize spin networks as knots acting on knots to create knots in rich coupled cycles – similar to metabolisms –, therefore as fundamental agents. As we have shown (Zimmermann and Díaz, 2012a), the Braunstein-Ghosh-Severi (BGS) entropy applied to spin networks allows us to put forward generalized conditions of autonomous agent in the sense of Stuart Kauffman.

(3) According to this viewpoint, on the one hand, agency dynamics can be mapped through *game theoretical* applications; on the other hand, evolutionary system dynamics can be mapped through mathematical *category theory*. By these means we expect a proper embracing of the hierarchy of complexity.

(4) Concerning the fundamental attributes of the universe, we consider that the pair *energy-matter*, can be regarded alongside the pair *information-structure* (representing such bipolarity the difference and relation between potentiality and actuality). Whereas energy is conceptualized as potentiality to perform work (change), we claim that information can be visualized – from the outset – as potentiality to utilize such work in benefit of the organization of the system, being structure the actualization of such organization potential represented by information. In other words, information can be regarded as potentiality for building the constraints and affordances that enables propagating work.

(5) In cognitive and social contexts, we deal with agents who have self-reflection and try to reconstruct objects and situations from essentially limited information (Díaz 2011a-c), in which the case of animal perception represents a basic level. To that purpose *hermeneutical agency* shall be introduced, in which the cycles defined by observation-representation can be seen in thermodynamic terms, and is the purpose for such agent the reduction of the complexity of the related representation, generally linked to some pragmatic situation.

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Systemic Approach in the Modern Management

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Abstract: *Success of management practice is strongly connected with the ability to vision and effective decision making. It is based on individual style of thinking (cognitive style). Though, development of manager's cognitive styles based on principles and methods of systemic approach has sufficient theoretic and practice value.*

Keywords: system; systemic approach; system thinking; cognitive style; management thought; organisation

Systemic approach in management is well known since cybernetics came in to management. It was very helpful in constructing of main principles of complex system's behavior. Generally speaking, each organization may be viewed as a system, i.e. complex entity, made up of different parts, e.g. in the form of departments or divisions. According to the systems approach school, management involves managing and solving problems in each part of the organization. The management thought is the main focus of the modern management. It deals with the problem of cognitive effectiveness – as the explication of effective problem solving and decision making. This is to be done with the understanding that actions taken in one part of the organization effect other parts of the organization, and its environment, and vice versa. In solving problems, therefore, managers must view the organization as a dynamic whole, focusing on the inter-dependence and inter-relationship of the various subsystems from the point of view of overall effectiveness of the organization and its environment.

Adherents of the systems approach consider universal process, scientific management and human relations theories as the study of management in fragments rather than in the whole. These theories assume that "the whole is equal to the sum of its parts." Systems theorists, in contrast, "study management by putting things together, and they assume that the whole is greater than the sum of its parts". Also there is the holographic paradigm claiming that to humans understand a system, it must be studied as a whole: instead of explaining a whole in terms of its parts, the parts should be explained in terms of the whole.

Chester I. Barnard, Ludwig Von Bertalanffy, Russel Ackoff, Kenneth Boulding and Jamshid Garajedaghi are among the writers who have influenced the systems approach in management.

C. I. Barnard was an early pioneer of the systems perspective. His work encouraged subsequent management and organization theorists to study organizations as complex and dynamic wholes rather than piecemeally. Barnard led to the opening up of a promising horizon in the development of management thought. The contingency management theory evolved out of the systems approach to managing organizations. According to the contingency approach, management is situational: no one single best approach to management exists because each situation that a manager faces is too different. Peter Drucker further suggests that a manager must be able to judge which technique is appropriate for a given situation (situational management). Anyway, it demands very strong cognitive competence of decision making persons. The modern management problems (for instance, decision making problem) lead to two ways. One of them is the way of system thinking development. At this way E.Morin, President of the Association for the Complex Thinking, has made a great contribution in a reform in thinking and formulated the main principles of complex thinking. Another way is interactive design metodology. It is developing by Russell Accoff's school of Systemic Approach in Management. In 1986, Russel Ackoff, in partnership with Jamshid Gharajedaghi, created INTERACT, a freestanding organization. It's interactive design methodology has enabled individuals and organizations to gain control over their future. The design methodology has been used to achieve an order of magnitude improvement in the performance of throughput systems. Jamshid Gharejedaghi as the partner & CEO of INTERACT, is one of the original contributors to the development of the third generation of systems thinking, where iterative, interactive design forms are the core of systems methodology. It reflects in his popular book "Systems Thinking: Managing Chaos and Complexity". We presume that the above two ways are deeply connected by cognitive aspect of managing. And we consider the cognitive leadership, as the foundation of successful management practice, demands the proper way of thinking. Obviously, success of management practice is strongly connected with the ability to vision, effective decision making and aware management by values. Though, development of manager's cognitive styles based on principles and methods of systemic approach has sufficient theoretic and practice value. However, it may be said in conclusion, that the systemic approach is an instructive way of thinking rather than a collection of final answers to managing modern organizations.

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Complexity in Management of Inventions to Innovations

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Abstract: *The management models assure that daily problems will be properly solved as well as long-term serving the community will be assured. Development of society is possible only with the increasingly innovative management.*

With the capitalistic and especially neo-liberal economic model the development was overemphasized in some areas (consumer products like automobile, pharmacy, electronics or clothing, sophisticated financial and banking products) while at the same time in the same most developed countries the average education level, health care or democracy has not achieved the same level of advancement. Profit as a goal of industrial production includes only certain elements. Globally the profits have accumulated only in the hands of 2% of world population. When raw materials and parts will be produced at standards of developed countries and workers and employees worldwide will be paid the fair price and enjoyed the same benefits we can approach a more sustainable world system. In the current system only entropy (as in dialectical system´s theory) rises, moves between countries, and spreads (in the terms of pollution, illegal drugs, natural disasters, terrorism, …).

We believe that many countries were not able to manage the complexity of social development processes. The term management in this paper will refer to human dealing with people as they are. With dialectical system theory we can identify the areas, departments, specializations that need to be included in the (complicated) management systems. Their influences, connections and interrelatedness represent a more (un)manageable (complex) system. We will present and discuss a management model of Japan described with historical development, culture, value system, educational system, and economic organizations in the area with common cultural, national, or geographic characteristics. We believe that social environment deeply impacts the management models. The different values systems reflect in different company and social goals. While many USA or EU companies are short term profit oriented this reflects also in their invention-innovation processes. On the other side we find that some Japanese companies include the philosophy of serving the community and being respected in the society. Also the culturally bound idea of building harmony in family and work group better supports the environment where idea creation and invention development processes can be manageable. Some of their values in management system support more socially responsible decisions in the invention-innovation process.

Keywords: complexity; dialectical system theory; invention; innovation management; social responsibility

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Managing Complexity by Innovation

Changing the Game by Proliferating Meaning

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***Abstract:** To remind the trivial: innovation constitutes the means of societal rejuvenation substantiating metamorphosis. Innovation appears symptom, origin and driver as well as result of societal change. Innovate, or lose and decline. The ubiquitous shifts of globalisation need be met by proactive adapting innovation. Adaptation extends to fundamentally changing preconditions in virtually any domain. It calls for continuous root novelties. They affect competition and co-operation in any domain of life. Evolutionally the focal pivots for innovation lie in the dynamics of complexity and meaning in societal life. Innovation itself needs comprehensively be re-designed: societal function, target and objectives, modes and instruments. It pertains the entire culture and civilization process.*

Keywords: societal rejuvenation; ubiquitous change; complexity/ meaning dynamics; root innovations; re-designing the innovation process.

Acknowledgement: The argumentation reflects lifelong experience and learning in innovation practice, in teaching and consulting; in particular related to industry. Though originating from a differing background and reasoning the resulting concept in particular of 'Enabling spaces' of MF Peschl and Th, Fundneider complies with the views developed in part 4. of this paper. - I gratefully know myself indebted to all my partners in dialogue for their contributions.

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*1932 Germany. Classical education; Interdisciplinary thesis. Strategy Controller in Industry; in parallel teaching from Practice for Practice: e.g. Management, Learning; Creativity, Innovation. Co-operation with scientific societies. 1994 > Independent Research. Since 1955 Systems research, 1961 connection St. Gallen. Consulting, MBA workshops. Societal field research e.g. RSA. Actual: Transdisciplinarity, Pragmatic Philosophy, Epistemology, Complexity / Semiosis Dynamics, Biosemiotics. Learning, Change Guidance/Control, Innovation. Shaman research.

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The Importance of a Management System for Social Responsible Pre-school Institutions

On the way to a higher level of managing pre-school institutions

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Abstract: *There is a growing awareness for the importance of quality service also in pre-school institutions. According to some authors in this field, there is a potential for a pre-school education institution that wants to strive for a value added in terms of meeting ever growing society expectations, social responsibility and sustainable development that it learns from business-systems-like quality approaches. Through our practice of cooperating with and assessing some of pre-school institutions in Slovenia with and without a management system, we have also identified potentials that affirm importance to introduce and provide sustenance for a management system in pre-school educational institutions. In the paper we are analyzing current practices and results of those pre-school institutions in Slovenia that have already implemented such approaches. Furthermore, we are spotlighting those specific key elements for pre-school institutions that obviously should be integrated in their potential management system - regardless if they decide for a commonly standardized approaches (such as ISO 9001 quality management system) or if they stick to follow their proprietary management system.*

Keywords: pre-school education; kindergarten; quality management; management system; value added; social responsibility

Introduction

The awareness of the importance for higher quality service is growing also in the sector of pre-school institutions (Belfield & Schwartz, 2007). The authors imply that higher quality pre-school approaches accelerate children's cognitive growth what is especially essential for children from less advantaged backgrounds. Furthermore the results of some rare research works in this area (Niikko & Nuutinen, 2009; Williams et al., 2009) show that pre-school education systems should be revised to emphasize the needs for improvement in the area of management, cooperation, expectations of modern society and the aims of national curriculum.

We have highlighted an idea for a pre-school education institution that wants to strive for a value added in terms of meeting ever growing society expectations, social responsibility and sustainable development that it learns from business-systems-like quality approaches. Some researchers (Johnson & Golomski, 1999) have also shown that this is a reasonable attempt to achieve improvements in two areas – improving the business operations side of educational institutions and to shorten the time to notice when a child's performance is heading towards an unacceptable level. Through our practice of cooperating with and assessing some of pre-school institutions in Slovenia with and without a management system, we would extend these impact areas for institutions with a management system especially in regard to providing a higher degree of social responsibility. The later is reflected not only in the educational (core) process itself, but primarily in identifying who their stakeholders and their interests actually are and next in assuring their expectations are met in a mutually beneficial way. The mutually beneficial way implies to the awareness of stakeholders that not only expectations, but active cooperation with the aim of higher value creation should be sought for. We established that introducing a management system into pre-school institutions is a good start for achieving the mentioned awareness in the institutions themselves as well as by their stakeholders.

In the paper we will emphasize the parallels that affirm the reasoning of importance to introduce and provide sustenance for such a management system to guide the activities of pre-school educational institutions. The contribution will comprise the analysis of current results and practices of some pre-school institutions in Slovenia (case studies) that already have implemented such managerial approaches. Further, the contribution of the paper will be to discuss the key specific elements that obviously should be integrated in such a management system, regardless if this is a commonly standardized approach (like ISO 9001 quality management system) or it is a management system, based on organization's proprietary solutions.

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Social Responsibility in Slovenia

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Abstract: *Social responsibility (SR) is a complex construct applied to various degrees, means and ends in the social sciences as well as in the managerial practices. This problem was only partly resolved by the new ISO 2600 standard on social responsibility, published in November 2010 (See: ISO 26000 2010). The ISO 26000 brought to the forefront two novelties: the interdependence and holistic approach as the linkages between the 7 core subjects (organizational governance, human rights, labor practices, the environment, fair operating practices, consumer issues, and community involvement and development). However, the standard has a recommendatory status, which makes it flexible and avoidable, at the same time, legally, but unavoidable in market competition.*

Does and to which extent, if it contributes, SR contributes to the successfulness of the organizations was the main research question of the structured interviews and surveys conducted in 2409 selected Slovenian organisations, in which the managers and employees were involved. The following hypothesis was tested: SR in Slovenia is based on four fundamental constructs (Good Relationships with broader environment, Relationships with employees, Customer relationships, and Leadership/ company policy). The results showed that the Customer relationship is the most representative construct of the SR in Slovenian organizations.

Keywords: social responsibility; requisite holism; well-being; Dialectical Systems Theory

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International Educational and Scientific Links of Georgia – the Shortest Way for Innovative Development

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Abstract: *The article deals with the international educational and scientific relations of Georgia. Namely, its participation in Tempus, Twining and Erasmus Mundus programs and international relations of Shota Rustaveli Science Foundation. These links promote development of long-term and close relationships between countries.*

Georgia gained independence over two decades ago and now it is a transition economy country. Reforms are carried out in the system of science and education of the country as well as for improving the business environment and protecting intellectual property. Though, scientific study of the current reforms is presented only as separate evaluations, which, from our point of view, is not sufficient for achieving long-term effective results.

By presenting educational and scientific links in the paper together, we aimed to express our opinion on who and how should begin development of the policy which will prepare basis to move the level of development of the country to a higher one.

In order to achieve the above mentioned goals, we think it's necessary:

- to unite the current reforms in the country under one, long-term innovative policy, which will be developed based on knowledge triangle (education, science, business) and cluster concepts;

- innovative policy should be initiated by the Ministry of Science and Education of Georgia, as it manages reforms in the fields of science and education;

- to develop a multilevel education policy (namely, education for education, education for involving Georgian scientists in European research system, education as a business and education for creating a knowledge triangle in prioritative fields of the country) on the basis of existing international educational and scientific links. This will ensure introduction of leading standards in the country.

Thus, the shortest way of innovative development of the country goes through international educational and scientific links of Georgia.

Keywords: education; science; knowledge triangle; cluster; innovative development

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Symposium O. Dichotomies in Systems Biology

Chairs: Joris van Poucke, Centre for Critical Philosophy, Ghent University, Ghent, Belgium, and Veli-Pekka Parkkinen, Department of Philosophy, Classics, History of Art and Ideas, University of Oslo, Oslo, Norway

Since the advent of Systems Biology at the turn of the century, a plethora of approaches, opinions, definitions, etc., on its meaning and significance have emerged. Notwithstanding this multitude, there are some clear lines to be drawn between an empirical, local approach that is close to previous molecular research and a more idealistic, global approach that has more affinities with some typical systems approaches. Various proposals, such as the "research cycle" by Kitano, were made in order to establish a fruitful working methodology hoping that both traditions can meet each other "in the middle".

In addition to this debate, there is the dichotomy between structure and function, which is of equally importance to Systems Biology. Because of new high-throughput technologies, that produced huge amounts of structural data, molecular biologists were forced to turn to global approaches in order to make sense of the data. By doing this, however, they lost the biological meaning and relevance of certain local processes and are stuck with the global, structural interpretations of the data.

The challenge, so will be discussed, is to think of the appropriate relationship between the global and the local level, the idealistic systems approach and the empirical biological approach, between structure and function The question is how they can be related with each other without falling into a reduction to one or the other level.

Inese Polaka & Arkady Borisov: *Robust Dimensionality Reduction in Bioinformatics Data*

Tudor Baetu: *The Integration of Mathematical Modeling in Molecular Biology*

András London, Gábor Simkó, Ágoston Mihalik, Kristóf Kubina, Marcell Stippinger, Shijun Wang & Peter Csermely: *Changes of Exploitation and Exploration with Network Position and During Crisis*

Fridolin Gross: *The Sum of the Parts*

Madara Gasparovica & Ludmila Aleksejeva: *Rule Weight Use in Bioinformatics Data Classification*

Sophia Efstathiou, Annamaria Carusi, Martin Kuiper, Astrid Lægrid & Rune Nydal: *Research Systems for Systems Biology*

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Robust Dimensionality Reduction in Bioinformatics Data

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Abstract: *This article proposes a technique to reduce data dimensionality in bioinformatics tasks. In the cases where there are thousands of attributes and only few hundred instances even the scalable classification methods benefit from diminishing the number of features. But at the moment there is no way of finding the best feature selection and evaluation method for a particular data set and the performance of these methods varies a lot depending on the specific nature of a data set. Therefore it is necessary to find a robust technique that would perform the process of feature selection without the impact of a specific method. The system proposed in this article minimizes this effect while still producing highly informative feature subsets that are easier to comprehend, interpret and use in classification.*

Keywords: feature selection; data mining; classification; bioinformatics

Acknowledgement: This work has been supported by the European Social Fund within the project «Support for the implementation of doctoral studies at Riga Technical University».

One of the solutions to the problem of high dimensionality in biomedical and omics studies is data mining methods that depict the information and knowledge in such ways and structures that are familiar to all fields of research. An approach to this issue can be found in data mining techniques of dimensionality reduction. Such techniques are already used in other fields of research and can be successfully applied to high-dimensional data like those of bioinformatics (gene or protein microarrays). But there are no guidelines to select the most appropriate feature selection or evaluation technique. A use of data-mining based techniques is proposed in this study and blended into a system that allows processing bioinformatics data with high dimensionality without losing indicative information or interpretability. The system selects the most informative features based on several different evaluation techniques and then selects the features that are recognized as significant by most methods. Furthermore, the experiments show that the array does not lose significant information and the discriminative powers of classification models are similar or higher (due to avoidance of overfitting in large attribute sets).

1. Classification

Classifiers used in this research are the most popular classification methods in bioinformatics so far (according to the available literature) – Random Forests (Breiman, 2001), that create several tree-based structures that depict hierarchical relationships between features, and SVM (Vapnik, 1995) that bases the classification on finding functional relations in class discrimination. Another method that was included in the experimental study is C4.5 algorithm (Quinlan, 1993) that builds tree-based models of classification that are easily interpretable by experts, who are not related to data mining, and present the inter-feature connections.

2. Feature selection

There are several feature selection techniques that analyze the ability of a feature or a group of features to discriminate between target conditions. These techniques allow selecting a small subgroup of features that hold the most information about the specific condition. But the problem with these techniques is their unstable nature because the best selection technique in one data set may perform poorly (select less informative features than other methods) in another data set and also change its performance as the data set increases, which is a common case in bioinformatics because new experiments are often performed using the same gene/protein libraries for microarrays (Saeys, 2007).

3. The proposed system

The system proposed in the study includes the preprocessing of data, by imputing missing values (the data sets are normalized after scanning by BMC), finding subsets of autoantibodies with significant discrimination abilities and computing a disease classification model in the terms of autoantibody panel and interactions between autoantibodies in a form of a decision tree. The scheme of the system is given in the Figure 1.

The selection of the feature subset is implemented using various feature subset selection methods and evaluation techniques to eliminate the impact of the method – our previous studies have shown that different methods give changing results based on the specifics of data sets. The robustness of the feature subset is ensured by using different evaluation metrics (Chi-squared, OneR classifier, Information gain etc.) to select the preliminary groups of autoantibodies and then the system filters the features that are present in more than *n*% of the subsets (*n* is changed between sets of experiments to explore the changes in classification accuracy). This ensures that only the truly significant features are present in the feature subset – a feature can be selected because of the specific nature of data by one method but the used methods differ enough to avoid inclusion of such random into the ultimate feature subset.

This final autoantibody panel is then used to build a decision tree classification model using the standard C4.5 algorithm that holds the most significant autoantibodies and explains their inter-relations.

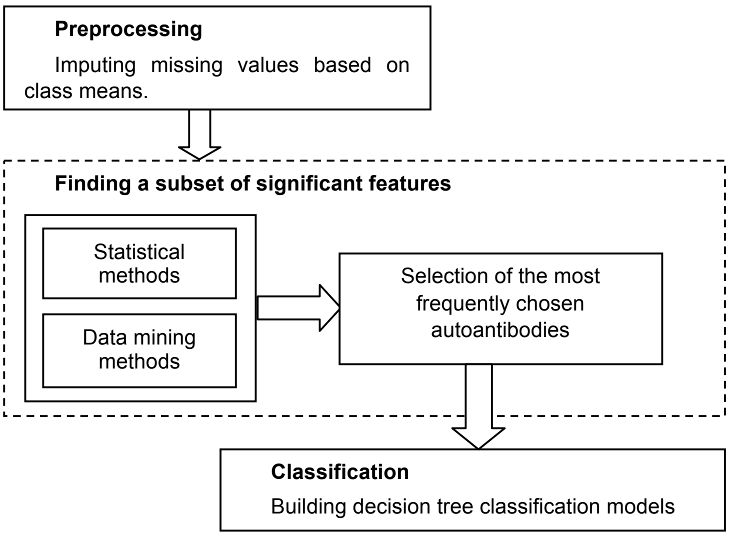

Figure 1: Autoantibody array data processing system

The results of the previous studies (Polaka, 2011) suggest that the accuracy of discrimination between affected patients and healthy individuals does not significantly decrease and in some cases it improves due to the overfitted models built on full data. The experimental results of the most frequent feature subsets were compared to the average results of other feature selection methods that rank features separately (Chi-squared, Information Gain, Gain Ratio, OneR, ReliefF) with the corresponding number of features per set. The results show that the proposed method beats the average result of other methods in 19 cases out of 45, one result was tied and 25 were slightly worse than the average (in seven cases the loss in accuracy was less than half percent). The average change in accuracy of C4.5 was -0,95 percent, for Random Forests it increased by 0,54 percent and for SVM it increased by 0,41 percent. When the classification results of most frequent feature sets were compared with the worst results of other single feature selection method, the proposed method presented better results in 38 out of 45 cases. The average accuracy increase for C4.5 was 1,3 percent, for Random Forests it was 5,63 percent and for SVM it was 4,82 percent.

This means that choosing the most frequent features over several evaluation methods leads to better feature subsets in most cases and it allows escaping the consequences of selecting the wrong feature selection method. It will not grant the best possible results but the selected feature subsets perform well in most cases and allow skipping the search for the best method that could turn out being worse as the data set grows in size and the number of records increases.

4. Conclusions

The experiments show that the Frequent feature data subsets perform at the average level of other methods but provides the necessary robustness for the large-scale and changing data of bioinformatics, without the risk of choosing the wrong feature selection method that would decrease the results of classification.

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The Integration of Mathematical Modeling in Molecular Biology

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Abstract: *The emergence of systems biology is marked by a revival of mathematical modeling in life sciences, hinting towards more theoretical alternatives to current causal-mechanistic explanations and experimental practices in molecular biology. This paper aims to provide a better understanding of how mathematical models can provide new insights about the causal processes responsible for producing biological phenomena. I argue that molecular biology and systems biology elucidate different aspects of molecular mechanisms. Mathematical models offer putative explanations of poorly understood aspects of molecular mechanisms, most notably minute quantitative and dynamic aspects of the biological phenomena generated by molecular mechanisms. Furthermore, quantitative models reveal novel and strange properties of molecular mechanisms.*

Keywords: systems biology; molecular biology; integration; mathematical models; mechanisms; mechanistic explanation

Systems biology aims to provide a "conceptual framework that is holistic, quantitative and predictive" (Kritikou et al. 2006, p. 801). One strategy by means of which systems biologists hope to achieve these goals is developing discrete and continuous mathematical models of protein and/or gene networks [reviewed in (Shmulevich & Aitchison 2009)]. It is interesting to note that the starting point of most modeling efforts is prior knowledge of molecular mechanisms (e.g., signal transduction pathways, genome expression regulation mechanisms, metabolic pathways). Molecular mechanisms are the hallmark of molecular biology, a discipline that deals with the molecular basis of biological activity, and which explains biological phenomena by showing how these phenomena are produced or maintained by organized systems of entities and activities (Darden, 2006).

The purpose of this paper is to provide an answer to the question "How do the molecular and systems approaches fit together?" I argue that molecular and systems biologies elucidate different aspects of molecular mechanisms. On one hand, mathematical models built from mechanism schemas cannot account for all the features of a phenomenon produced by a mechanism. On the other hand, however, mathematical models of molecular mechanisms can reveal 'black-boxes' in the mechanistic understanding of biological phenomena, especially in respect to quantitative and dynamic aspects. Furthermore, modeling allows for 'proof of principle' explanations of how molecular mechanisms can generate their target phenomena down to minute quantitative/dynamic details.

1. Mechanism Schemas Act as Bridges Allowing the Transfer of Knowledge from Molecular Biology to Systems Biology

Networks are abstract entities that may be used to describe a wide variety of structures. In the case of molecular networks, nodes represent entities (genes, proteins), while the connections between nodes represent activities (chemical reactions, activation/inhibition). In contemporary modeling studies, previous knowledge of molecular mechanisms determines the wiring structure of networks. Based on a number of case studies from the recent scientific literature, I previously argued that molecular networks amount to mechanism schemas obtained by abstracting all high-resolution biochemical details and most molecular details (Baetu in press). Specific modes of action and the structure of entities are not represented, in order to yield highly abstract schemas consisting of unstructured entities (proteins, genes) and generic activities (activation/inhibition, increase/decrease in concentration).

It follows from here that models built from mechanism schemas cannot account for all the features of a phenomenon produced by a mechanism. For example, a gene regulatory network representation of a signal transduction pathway does not tell us how a repressor protein regulates gene expression; the repressor may bind DNA directly, it may cause RNA polymerase to detach from DNA, or it may trap a key transcriptional activator in the cytoplasm.

2. Mathematical Models Reveal and Explain some of the Remaining 'Black-Boxes' of Molecular Mechanistic Explanations

A distinguishing characteristic of traditional molecular mechanistic explanations is their qualitative nature. For example, a spike of T-cell gene expression following exposure to pathogens is explained by a negative feedback regulatory mechanism whereby a transcriptional factor is initially activated, then subsequently inactivated by an inhibitory protein coded by a gene under its transcriptional control [e.g., the NF-κB/IκB regulatory mechanism (Sun et al., 1993)]. Nevertheless, even though such a mechanism can explain in a qualitative way how a peak of gene expression followed by a subsequent shutdown is produced, the absence of a quantitative understanding of the dynamics of the mechanism constitutes a 'black-box.' For instance, if the inhibitory protein is synthesized too fast, there is no peak of activation; conversely, if the inhibitor is synthesized too slowly or in insufficient quantity, gene expression is never turned off. Thus, it is reasonable to conclude that the mechanistic explanation is not complete unless we understand minute quantitative and dynamic aspects of the target phenomenon.

Recent studies illustrate how mathematical models can reveal discrepancies between the simulated output of quantitative models and experimental characterizations of phenomena generated by molecular mechanisms. For example, a simplified 4-parameter mathematical model of a negative feedback loop mechanism reveals three possible outputs, namely perpetual oscillation, damped oscillation, or a plateau of activation, yet none of these three possible outputs matches the shape of the observed spikes of T-cell gene expression (Hoffmann et al., 2002). The authors of this study interpreted this mismatch between the simulated results of a quantitative model of the molecular mechanism and experimental data as an indication the mechanistic explanation is incomplete. Their interpretation turned out to be correct. Explorations with mathematical modeling showed that a peak of activation is achieved by a combination of two partially overlapping regulatory mechanisms, one involving a negative regulatory loop, the other, constitutive expression of the inhibitor at low-levels. It is important to keep in mind that one cannot figure out this kind of additive effect by understanding mechanisms in a purely qualitative way. Numerical computation is necessary, and this is precisely what mathematical models allow.

Such studies reveal novel properties of molecular mechanisms, not found in other kinds of mechanisms. Most notably, they provide insights about the role of redundant genes and proteins: many seemingly redundant mechanistic components may in fact be non-redundant; rather, their role it to generate physiologically relevant variations of the same mechanism. These studies also provide insights about the population nature of molecular mechanisms: many biological phenomena may be produced not by a single mechanism (or a population of identical mechanisms), but by heterogeneous populations of partially overlapping mechanisms (i.e., mechanisms sharing several components).

Finally, mathematical models introduce novel reasoning strategies. In the example sketched above, quantitative analysis reveals a discrepancy between the simulated output and the actual output; it is further inferred from here that the standard mechanistic explanation is insufficient to explain the phenomenon under investigation (Hoffmann et al., 2002). Conversely, quantitative models can also demonstrate that the proposed mechanistic explanation is sufficient to generate minute quantitative/dynamic features of the phenomenon under investigation. Quantitative sufficiency states that the proposed mechanism is sufficient to produce the phenomenon under investigation in the right amount/intensity [e.g., allometric growth of lung bronchioles (Tang et al., 2011)]. Parameter sufficiency is a more ambitious inference. Since model predictions match experimental data, it is argued that a more complex model including additional parameters is not needed, and therefore it is likely that all the relevant mechanistic components have been taken into consideration [e.g., (Tang et al., 2011)].

3. Conclusion

On one hand, models built from mechanism schemas cannot account for all the features of a phenomenon produced by a mechanism. On the other hand, however, the same models can provide putative explanations of how molecular mechanisms can generate their target phenomena down to minute quantitative/dynamic details. Thus, molecular and systems biologies elucidate different aspects of molecular mechanisms. Under this interpretation, mathematical modeling is an attempt to open remaining ‘black-boxes’ in our understanding of mechanisms.

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Changes of Exploitation and Exploration with Network Position and During Crisis

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Abstract: *Changes in stability and adaptation of complex systems is reflected by gross changes in their network structure. Inter-modular, creative nodes play a key role in the crisis-adaptation of complex systems. System level behavior is well characterized by cooperativity of nodes in spatial social dilemma games. Creative behavior is crucial for maintaining network topology-independent cooperation in spatial game contexts. Hubs, interlinked hubs and inter-modular positions emerge as crucial determinants to maintain cooperation. Our findings suggest that optimization of exploitation/exploration trade-off is reflected by an intermediate position between extremes of rigid, cumulus-like and flexible, stratus-like network topologies.*

Keywords: adaptation; cooperation; creative node; crisis; network; network modules; Prisoner's Dilemma game; protein-protein interaction networks; spatial social dilemma games; stress, yeast

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The network approach became more and more important in the last decade. Development in our data acquisition and storage capacities allowed us to collect and study enormous amounts of data on complex systems. Networks not only give us a visual image of these complex systems providing an instant recognition of groups and important elements, but also have a number of topological features, which are general properties of biological, social and engineered networks. The small-world character, the existence of hubs, modules, hierarchy, the stabilizing role of weak links and many others are amongst these features (Csermely, 2009). Our highly multidisciplinary group (www.linkgroup.hu) uses networks as 'highways' making the transfer of concepts between various disciplines rather easy. This concept-transfer embeds the original idea to the entirely different linguistic and conceptual context of another scientific field, and helps to solve creativity deadlocks (Farkas et al., 2011).

1. Creative network nodes

Inter-modular nodes, such as the highly dynamic 'creative nodes' play a particularly important role in network exploration (Csermely, 2008). Their presence plays a key role in the complex systems' potential for fast adaptation (called evolvability in biological systems). These elements bridge Ronald S. Burt's (1995) 'structural holes', and provide a key subset of Mark Granovetter's (1973) 'weak links'. Active centers and binding sites of proteins often occupy such a position in protein structure networks. As the complexity of the system increases, the mobility of creative elements expands, and covers more and more the entire network. Creative nodes emerge as crucial determinants helping crisis survival and evolution (Csermely, 2008).

2. Creative nodes in crisis adaptation – an example of yeast cells

The importance of inter-modular, creative nodes in crisis adaptation was demonstrated on the systems level crisis responses of a yeast cell. When the community structure of the protein-protein interaction network of yeast cells was studied using our recently developed method, ModuLand (Kovacs et al., 2010; www.linkgroup.hu/modules.php), the overlap of protein communities decreased, and protein-protein interaction modules became partially disintegrated as an initial response to stress. The stress-induced decrease of inter-modular connections was beneficial, since it A.) allowed a better focusing on vital functions, and thus spared resources; B.) localized damage to the affected modules; C.) reduced the propagation of noise; D.) allowed a larger 'degree of freedom' of the individual modules to explore different adaptation strategies; and E.) helped the 'mediation of inter-modular conflicts' during a period of violent intra-modular changes. Modular reorganization emerged as general and novel systems level way of cost-efficient adaptation (Mihalik & Csermely, 2011).

3. Creative behavior is crucial for maintaining network topology-independent cooperation in spatial games

Cooperation level of spatial games, such as that observed in the Prisoner's Dilemma game is very sensitive for network topology. However, if rules for updating the strategy contain both 'learning' (i.e. memory of payoffs in previous rounds of the game) and 'creativity' (in the form of a low level of randomness to switch defection back to cooperation, if cooperation becomes extinct) the level of cooperation will not only increase, but will also become rather independent from the topology of the complex network (Wang et al., 2008). Thus creativity is important to maintain cooperation not only at the level of network position (in form of creative nodes; Csermely, 2008) but at decision patterns, too.

4. Changes of exploitation in crisis – cooperation-changes in Prisoner's Dilemma games of protein networks

We have examined various ratios and starting positions of cooperators in the protein-protein interaction network of normal and stressed yeast cells using the NetworGame program package developed by Gabor Simko (Farkas et al., 2011; www.linkgroup.hu/NetworGame.php). In case of multiple defectors at the starting position we observed a smaller final level of cooperation in Prisoner's Dilemma games in stressed as compared to normal yeast networks. On the contrary, if a single defector was introduced, stressed yeast cells displayed a higher cooperation than that of normal cells (Stippinger & Csermely, unpublished observations). This differential behavior shows the importance of the segregation (cohesion) of modules on the stability of cooperation.

5. Inter-modular positions have a key importance to maintain cooperation in spatial games

When single defectors or cooperator pairs were introduced to various starting positions of real world networks in repeated Prisoner's Dilemma games using the NetworGame program (Farkas et al., 2011; www.linkgroup.hu/NetworGame.php), a large variability of influences was observed on the final level of cooperation. Encouraged by these results we defined defective and cooperative game centralities as novel measures of the dynamic influence of individual nodes or node-pairs on network behavior. Examinations of various biological, engineering and social networks showed that hubs, hub-hub cores, and inter-modular nodes play a crucial role in the maintenance of cooperation of complex systems (London, Simko & Csermely, unpublished observations).

6. Optimization of exploitation/exploration trade-off is reflected by an intermediate position between extremes of rigid, cumulus-like and flexible, stratus-like network topologies

As we summarized recently (Csermely et al., 2012) networks seem to segregate to two basic conformations, the stratus- and cumulus-like network topology. As introduced first by Batada et al (2006) stratus-type networks are similar to flat, dense (dark) low-lying clouds, while cumulus-type networks are similar to puffy (white) clouds. Networks with a cumulus topology have a rather disjoint, multi-centered modular structure. Such a structure has a rather limited overlap between the modules, which implies a higher cohesion and rigidity of the individual modules. Networks with a stratus topology have a rather coalescent structure resembling that of stratus clouds. Such networks have a large overlap between their modules to the extent that modules can not be readily distinguished from each other. This implies a high flexibility of the entire network. As we showed earlier stress induces a stratus → cumulus transition in yeast protein-protein interaction networks (Mihalik & Csermely, 2011). Cumulus-type networks are optimized to the exploitation of their current behavior, and (in their extreme form) are rigid to the extent that they are unable to change, i.e. they are unable to learn. On the contrary, stratus-type networks are optimized to the exploration of alternative options, and (in their extreme form) are flexible to the extent that they are unable to get a stable state, i.e. they are unable to remember. Optimization of exploitation/exploration trade-off is reflected by an intermediate position between extremes of rigid, cumulus-like and flexible, stratus-like network topologies (Csermely et al., 2012).

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The Sum of the Parts

Molecular Biology and Systems Biology as Heuristic Research Strategies

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Extended Abstract

In my contribution I want to argue that it is not helpful to assume a neat division of the field of systems biology into "local" and "global" approaches. This kind of dichotomization seems to be largely driven by an ongoing rhetoric between different groups of researchers. Contrasts e.g. between 'reductionism' and 'holism' are invoked at a level of discussion that is far removed from the actual scientific practices of systems biologists. In order not to be misled, I suggest to focus on different individual approaches and to find a way of determining their 'epistemic distance' with respect to traditional molecular biology. I will show that in this way one can both get a better idea of the actual heterogeneity of the field, and more easily assess the prospects of integration.

The intended analysis requires, first of all, a fair portrayal of the epistemic framework and commitments underlying the traditional approach of molecular biology. I argue that the framework of mechanism, supplemented by a flexible set of more specific heuristic strategies, adequately describes the activities of molecular biologists, while doing justice to the fact that molecular biology has undergone considerable changes throughout the second half of the 20th century. Moreover, I argue that the idea of discovering mechanisms of a particular kind is itself, first of all, a heuristic research strategy, driven by a need of simplification.

The next step consists in determining the extent to which approaches classified as systems biology deviate from this traditional approach. My focus is not only on the different kinds of scientific understanding that can be gained from adopting a systemic perspective, but also on the trade-offs that are involved in going beyond the framework of molecular biology. The guiding idea is that, in order to be successful, any conceptual approach in the life sciences must offer efficient heuristics, that is, ways to manage complexity. Therefore, any approach introduces biases by making certain simplifying assumptions about the system under study, without itself providing the tools to justify these assumptions. Systems approaches can be classified and related to the traditional framework according to the level of 'heuristic specificity' at which they propose modifications.

Framing the analysis in terms of heuristic strategies avoids drawing an overly simplistic picture of the different epistemic approaches and of the way in which they may conflict. Different approaches in systems biology are not seen neither as mere modifications nor as competitors, but as tools for the detection of biases in the traditional framework. Therefore, it seems that the prospects of integration in practice will crucially depend on an awareness of the respective limits of different approaches.

Taken as a case study for philosophy of science, systems biology also provides the opportunity to test the conceptual frameworks that have been put forward to describe the epistemic activities of biologists in general. Can ideas on discovery and explanation in the life sciences be maintained, or does systems biology represent a real challenge to the ways in which philosophers have attempted to capture research in the life sciences? I suggest that the philosophical analysis of systems

biology forces us to reconsider the limits of reasoning in terms of mechanisms, and to allow a more prominent role for alternative heuristics.

The result of such an analysis may, however, not only be of academic interest. Among the life sciences, systems biology represents one of the funding priorities in many countries, even though its ambitious claims, e.g. with regards to human health, are perceived as exaggerated by many observers. Should all molecular biology be turned into systems biology? Should some kind of synthesis be the goal, or should more traditional approaches and systems approaches be advanced separately? Attempts to find answers to normative questions like these might benefit from a philosophical analysis that aims at a realistic and impartial assessment of different approaches in systems biology and of their epistemological relationship to the traditional framework of molecular biology.

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Rule Weight Use in Bioinformatics Data Classification

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Abstract: *This article studies the possible application of fuzzy classification methods that use rule weights in in classification of bioinformatics data, in particular, it uses algorithms Fuzzy Rule Learning Model, whose results are compared to those of Fuzzy Unordered Rule Induction Algorithm. To assess the benefits of approach specifics, the experiments were carried out using eleven real bioinformatics data sets provided by University of Ljubljana, Faculty of computer and information science Bioinformatics Laboratory on their home page. The article provides conclusions about the efficacy of rule weight assessment methods and outlines the course of future research.*

Keywords: bioinformatics; classification task; fuzzy rule induction; rule weighing

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1. Introduction

Often in data mining there are specific algorithms created and applied to characteristic tasks that match them the best instead of using universal algorithms; but frequently they can be successfully implemented in other fields of data mining. This study examines the application of a pattern recognition algorithm in a classical data classification task using specific bioinformatics data that ask for definite algorithms due to their complex structure (large number of attributes and very few records). The article examines classification results of seven different data sets using Fuzzy Rule Learning Model algorithm (implemented in the data mining software KEEL (Alcalá-Fdez,J. et al., 2011)) and Fuzzy Unordered Rule Induction Algoritm (implemented in the data mining software Weka).

2. Experimental Study

The study uses an algorithm Fuzzy Rule Learning Model by the Chi et al. (Chi et al., 1995) approach with rule weights to determine its suitability to the specifics of bioinformatics data (thousands of attributes and few records). To assess this algorithm, its gain in other less complex data sets was compared to its accuracy gain in bioinformatics data, using FURIA algorithm (Hühn et al., 2009) as a benchmark for classification accuracy in bioinformatics data (Gasparovica, 2012). The datasets used for algorithm evaluation were taken from University of Ljubljana, Faculty of computer and information science Bioinformatics Laboratory on their home page (University of Ljubljana, 2012) and they contained gene expression data and other typical bioinformatics data with the previously described specifics. To evaluate the accuracy of the algorithms, the experiments were carried out using 10-fold cross-validation.

3. Results and Discussion

The experimental results show that when applying algorithm Fuzzy Rule Learning Model available in Keel software and using 10-fold cross-validation the results do not exceed the performance of FURIA algorithm in all cases. It can be explained by the specific nature of the data sets – the large number of attributes and comparatively small number of records (e.g., 12625 attributes and 24 records in the Breast cancer data set), therefore the rules induced in the training phase have a complex structure and cannot be interpreted as easily as rules obtained using FURIA. The small training set cannot provide enough information about class structures and the induced rules do not cover/satisfy the previously unknown instances from the test sets. Another aspect, why FURIA has more successful rules, is its ability to stretch rules to cover previously unknown new records that differ from the training set instances and classify them accordingly.

During this study some experiments were carried out to determine, whether the number of labels per variable has an influence on classification accuracy in tasks that are solved using rule weights. It was concluded that its influence is relevant – when the number of labels per variable is increased by one unit, the change in the results was minimal, but increasing it by several units showed a significant change in classification accuracy. The change mostly was negative – the increase in the number of labels per variable decreased the classification accuracy proportionally.

The future research could involve the use of rule weight technology but it should be adapted to bioinformatics data specifics and tasks, that would be a narrower solution that could not be used in all fields but, instead, fitted for bioinformatics data, where it would show comparatively high and robust results. Nevertheless, to evaluate and approve this theory, there should be more research carried out using other bioinformatics data sets. Future research also holds more studies of Fuzzy Rule Learning Model algorithm, its parameters and options.

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Research Systems for Systems Biology

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Abstract: *This paper examines key epistemological challenges involved in linking up local, experimental biological research with the development of global, biological knowledgebases, including the possible contributions that philosophy could bring to this science in the making. Our research is based on a collaboration between philosophers and systems biologist at the Norwegian University of Science and Technology (NTNU), implemented through the Crossover Research (CR) group of NTNU.*

Keywords: systems biology; philosophy; semantic web; epistemology; experiment; ethics

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Systems biology is a research strategy in which the function of individual biological components is studied within relational and interaction networks, hierarchies and pathway-dynamical constraints that exist in a biological system. Only by integrating knowledge from many sub-fields of biology can such a systems approach be taken. What currently has biological meaning and relevance is established locally, in the many local experimental systems where meaningful biological inferences on parts, bits and pieces of biological systems are made. Our paper explores the challenges this epistemic issue poses for systems biology research.

1. The dichotomy between the local and global as a crucial epistemic challenge for systems biology

Knowledge of biological bits and pieces has a contingent character, which simultaneously hinders and conditions systems biology. What makes biological sense is given locally in the various experimental systems designed for different research purposes within the sub-fields of biology. Alignment of local research strategies, via lab to lab and personal communications has resulted in a plethora of results, which are deemed reproducible and reliable on condition of the establishment of networks of standardization and alignment. This inspires a search for a globally functional and shared biological research vocabulary and knowledgebase, in which ontologies play a crucial role. However, this quest is in tension with the prevailing understanding of biological knowledge as obtained relative to a variety of often implicitly agreed upon, local research concepts, strategies and choices.

To facilitate the integration of 'local' knowledge from various sources into a global knowledgebase, a uniform, controlled semantics, and a structured form of interpretation of the knowledge is deemed vital. This has inspired the development of a large number of domain ontologies: formalised biomedical knowledge that can be used as semantic scaffolds for biomedical data (e.g. from biological component databases; the scientific literature; medical data from disease databases, electronic health records, etc). Semantic web technologies build on these ontologies to provide access to semantically integrated biomedical data and enable the mining, automated assessment and visualisation of these data. Biological analyses then, are to be facilitated by access to semantically integrated biological data that enable global biological inferences.

However, the fact remains that on the ground of biological research, knowledge is built piecemeal and entities are labeled in reference to their particular, local functionalities, understood within specified material experimental contexts, whether they be patients, diseases or molecules. Biomedical practitioners are some degrees removed from understanding the information stored in knowledgebases as systemically related to experimental, local knowledge. So the question arises, how does the construction of large-scale ‘global’ ontologies negotiate these tensions with the local, what kinds of knowledge does this negotiation involve, and what are its limits and possibilities What is the ‘knowledge’ stored on the knowledgebase level: what is it knowledge of, who knows it, and who should know it? Answering these questions is crucial for a well-constructed research strategy in systems biology.

2. The strategy of Systems Biology at NTNU

Researchers in the Semantic Systems Biology (SSB) group collaborate with the Gastrointestinal Systems Biology (GSB) group at NTNU with the aim to combine research on molecular mechanisms governing normal and pathological processes of the gastrointestine and especially cancer, with research on biomedical knowledge management, ontology development, query and reasoning technologies and analysis pipelines that allow the supply and consumption of linked open data and knowledge transfer in academic and industrial research. The push is in coupling these technologies to real biological problems and in training personnel to understand and support biological questions. A close collaboration with end-users is envisioned to allow a definition of the requirements for intuitive query formulation, the development of user-friendly visualisation paradigms and data mining technologies designed to solve concrete biomedical problems. This is further illustrated in Figure 1.

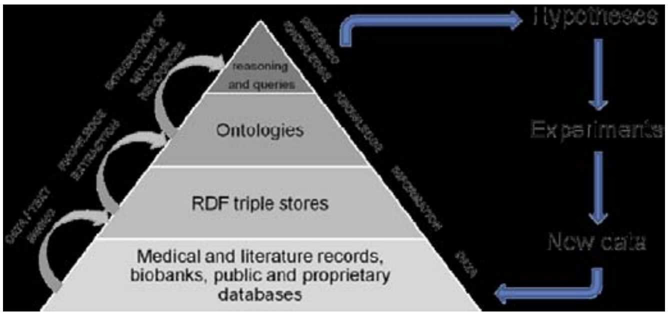

Figure 1: The data-knowledge pyramid in Semantic Systems Biology. Knowledge derived from data\text mining, knowledge extraction, and integration of multiple resources and is used for hypothesis assessment, experimental design and new data.

3. Implications for Systems Biology Research Systems

The challenges involved in formulating a well-constructed research system for systems biology are undoubtedly significant. One step towards addressing these is an understanding and specification of the full implications of the epistemic challenges posed by a dichotomy between local and global research, to the advancement of this field.

The inclusion of computational and semantic approaches raises the philosophical question of how to export knowledge derived in one system and apply it to another. This problem has several aspects. Systems biology envisions itself as working in a ‘wet’ lab and a ‘dry’ lab and a search for systems biological understanding seems to now implicate the search for proper information theory and techniques. Systems biology researchers are tasked with crossing available disciplinary boundaries and revising their research practices. Systems biology joins a practical, wet and material science which deals with very shifty and sensitive entities that it seeks to delimit or control with a computational science working with usually man-made, well behaved, axiomatically organized entities blown into multiple possible realms of abstracted, semantic, and complexly interacting systems. In the process of designing a joint research strategy, a systems biology research program is called to understand how different human research systems produce and manage their knowledge(s).

An important aspect of the divergence between existing epistemic practices in biology and computational science is that it impedes the formulation and management of coherent professional identities, motivations, commitments and abilities. The local experimental system is perceived by biologists as something complete, whole, relevant, which they control and can easily integrate into their ongoing work. The global knowledgebase (the idealistic, structural systems biology) on the contrary, is remote, incomplete, abstract, difficult to access and understand, and the invitation to contribute to it's making/shaping is not very attractive, as the result (a complete, comprehensive and understandable and holistic representation of biology) is a grand aim whose achievement, if realizable, lies many years ahead. Certain skills and traits suited for biological work may be ill-suited for computational work or vice versa, while the interests, tools and ethos of biology and computational science can vary...

Importantly, ethical issues are closely implicated with the epistemological challenges of systems biology, as managing scientific uncertainty, choice and dissent has to happen within a social and political milieu, with an eye to how scientific research will impact and translate into socially important outcomes. Biomedical deliverables are sought for and expected from the cutting edge of our scientific artillery. At the same time the monsters of biological research gone wrong (as with early 20th century eugenics) have permanently shaped research ethics and the public opinion. Successful systems biology is tasked with not only obtaining and storing but also with relating scientific knowledge in lay and easily communicable terms, while considering the ethical effects and side-effects of this research.

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Sophia Efstathiou studied Mathematics and Physics at Warwick (MPhys 2000) and completed her doctoral research at the University of California in San Diego, in Philosophy and Science Studies (2009), working on how tconcepts of race are used in different biomedical fields. She has developed an account of how commonly available concepts become usable as if they are scientific concepts, which she calls 'found science' by analogy to found art. Her postdoctoral research looks into how interdisciplinary work can make use of discipline-specific, 'founded' concepts, in aging research (Southampton University) and currently in systems biology research (Norwegian University of Science and Technology).

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Symposium P. Cognitive Relativity, Rationality and Clarity

Chair: Irina Ezhkova, International Institute of Applied Technologies, Brussels, Belgium

The CRRC principles provide a unified background for understanding, formalisation and support of different kinds of Systems of Communicating Emergent Contextual Systems. Despite the term "cognitive" the symposium is relevant to different environments where basic principles of self-organisation may help to understand and support different kinds of emergent and selforganising activities and infrastructures.

The principle of Cognitive Relativity recognises that there are different perspectives of observation of the same problem as well as of different problems by different actors, and that an observer (any actor, agent) can be placed into different points of observation with potentially different interests, cognitive spaces and different accurate scaling and measurements. This principle provides an extreme sensitivity to different situations, contexts, actors and users and may help to aggregate the whole vision of a complex reality into a well described, predictable and multicontextual picture.

The principle of Cognitive Rationality recognises that there are different kinds of rationality which may rule behaviour and decision making of different actors and that their different possible actions can be accurately modelled and well predicted on the same formal basis. This principle provides a constructive background for modelling of harmonised behaviour of different multiple actors in a complex multicontextual and emergent environment. It provides the unified platform for global strategic planning as well as for different kinds of emergent behaviour.

The principle of Cognitive Clarity recognises that there are clear ways of approaching and organising a real complex environment which may be very beneficial for increased comprehension and self-organising activities of different actors (agents, human, cultures, media and technical environment). This principle can recognise the most constructive means of different kinds of communication and organisation and may be used to predict their possible life-cycles. Languages, cultures, metaphors, organisations, technological standards, scientific terms and models may be considered as useful results of clarifications. The principle can help to recognise and predict different forms of emergent infrastructures, technologies and their possible ways of evolution.

These general self-organising principles can be used to understand, explore and harmonise different kinds of Emergent Opportunities and Emergent Architectures.

Irina Ezhkova: *Cognitive Relativity, Rationality and Clarity*

Gennady Osipov: *Computer Simulation of "Consciousness"*

Dzhavdet Suleymanov: *The Phenomenon of Hierarchy in the Tatar Language*

Boris Kulik, Alexander Fridman & Alexander Zuenko: *N-tuple Algebra: Providing Clarity by Combining Logical Inference with Defeasible Reasoning*

Alexander Fridman & Olga Fridman: *Combining Neural Networks and Incremental Techniques for Coordination in System of Systems*

Michael Lissack: *Representations and Compressions*

Gábor Szász, Svetlana Benedikt & Istvan Kun: *On a Subjective Control of Safety Level*

Mika Purhonen: *Is Macroeconomy a Self-Organising System*

Anatoly I. Timofeev: *Artificial Intellectual Hand: Capture Reliability Prognosis of Non-Oriented Complex Shape Objects for Manipulating Robotics*

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Dilyara Suleymanova: *The Concept of Well-being in the Russian and Spanish Linguocultures: Associative Classification*

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Cognitive Relativity, Rationality and Clarity

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Abstract: *The CRRC principles provide a unified background for understanding, formalisation and support of different kinds of Systems of Communicating Emergent Contextual Systems. Despite the term "cognitive" these basic principles of self-organisation are relevant to different environments where they may help to understand and support different kinds of emergent and selforganising activities and infrastructures.*

Keywords: cognitive relativity; cognitive rationality; cognitive clarity; emergent contextual systems; architecture of opportunities

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Prof. Ezhkova is an adviser of the International Institute of Applied Technologies. Her earlier work was concerned mainly with Automatic Logic Inference, Data, Knowledge and Context Based Systems, Decision-making Analysis and Information Systems. Her current research is focused on Continuously- Learning, Self-organizing Communicating Contextual Systems, Actor-centered and Distributed Cognitive Systems, and simulating of complex phenomena in real dynamic environments. Her last results were applied in Strategic Planning, Cognitive Economics and modeling origin, development and evolution of Cultural Systems. Irina Ezhkova received her degrees with excellence, including PhD in Mathematics and Physics from the Moscow Physical-Technical Institute and served as a senior researcher at the Moscow Aviation Institute, the Institute of Psychology and at the Computing Center of the Russian Academy of Science. She was a leader of several State Projects on New Information Technologies and New Generations of Computers. As a visiting professor she gave lectures on her technologies at many universities such as Cambridge, Oxford, London, Vienna and Rome. She was a distinguished reviewer and consultant on Information Technologies for international organizations, including UNIDO, the European Commission and European Parliament. She has about 100 publications.

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Computer Simulation of “Consciousness”

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Abstract: *Presented of computer model of forming new goal by the subject. Sign-based "Consciousness" and "Self-consciousness" models are designed. Established that goal-setting is function of "Consciousness" and "Self-consciousness" models. Components of signs are considered. The architecture of the intelligent agent possessing "consciousness" and ability to goal-setting is developed and experimentally investigated.*

Keywords: sign; behavior; goal-setting; “consciousness” model; cognitive necessity

The study of the phenomena of goal-directed behavior and its simulation is one of significant Artificial Intelligence problems. Main efforts are focused here on the synthesis of behavior plan in a predictable and unpredictable environment.

At the same time in the existing studies do not consider the problem of goal-setting – supposing of new goal, because a goal or set of goals are defined.

But, these two problems – supposing of a new goal and the plan synthesis inseparably linked and, as shown in a number of researches, for their decision are used other mechanisms, rather than in existing intelligent planning algorithms. These are motivation mechanisms, meanings, models of the mental world, etc. In other words, in the decision of this problem the leading role is played by consciousness and self-consciousness mechanisms.

In this report computer models of goal-setting - forming new goal by the subject for the first time are considered. Sign-based "Consciousness" and "Self-consciousness" models are designed. In other words, the consciousness is represented by sign-based dynamic model with set of dependences and the processes connecting as components of a sign, so sets of signs. Goal-setting is function of "Consciousness" and "Self-consciousness" models is established. Components of signs are considered. It is shown that interaction of these a component leads to forming of three types of mental models of the world of subjects: the mental model of the world based on patterns, as components of signs – a scientific mental model of the world, the mental model of the world based on personal meanings as components of signs – an common mental model of the world and the mental model of the world based on destination as components of signs – a mythological model of the world.

It is shown that the consciousness-based model of the behavior includes also the special kind of motivation accompanying work of consciousness.

The cognitive necessity will be transformed by consciousness to special necessity of work with signs –signify necessity. For this necessity sign components will be motives, therefore work of personal consciousness is realized through search of signs.

On this basis the architecture of the intelligent agent, generating of various types of models of the world, the goals and plans of behavior is implemented and experimentally investigated.

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The Phenomenon of Hierarchy in the Tatar Language

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Abstract: *The paper describes the methodological importance of the notion of hierarchy for complete and adequate representation of a natural language as a semiotic system. A double nature of hierarchy as an ontological (objective) and a gnosiological (subjective) phenomenon is revealed in respect to the language. Culturological dependence of hierarchical conceptions in the language as a proof of their cognitive relativity, rationality and clarity, is shown on the example of the Tatar language.*

Keywords: hierarchy; language levels; Tatar affixes; etymology of “hierarchy”

Hierarchy is one of the basic semiotic notions, which runs through practically all the linguistic phenomena from interrelation among elementary units to complex linguistic constructions. In spite of the importance and perspectives of the research in the aspect of hierarchal structure, the essence of a natural language as a semiotic system is still insufficiently studied. A natural language therefore can be viewed, firstly, as a complex object in the system of other languages, secondly, as a complex instrument for describing the picture of the world (cognitive aspect), for communication and exchange of information (communicative aspect), and thirdly, it can be used in systems and technologies as a tool for person-machine interrelation. A number of works published in Russia and abroad on the problem of hierarchy and interaction of linguistic universals [1, 2, 3, 4, 5] confirm actuality and methodological value of bringing the notion of hierarchy into the language research. These works mark the first steps on the way to the hierarchical conceptualization of languages.

Apparently, the notion of hierarchy, even if studied exclusively within the linguistic area, reveals itself or conceptualizes itself in different aspects: philosophical, general scientific, narrow-subject and culturological. Therefore it should be included in corresponding professional and linguistic dictionaries; they would fix this natural and all-embracing phenomenon of hierarchy in concepts which help widen the world, regulate it and thereby add clarity, determinacy, not necessarily absolute but also relative or even subjective.

Different definitions of hierarchy come into existence; as a rule they are equally and unambiguously interpreted within the same culture, in regard to the notions of the same mentality. This is reflected in the language as an instrument, as some lexical or grammatical phenomenon which makes it possible to portray natural hierarchy, or a hierarchy perceived as such in a certain culture. So there is not only interrelation but also interdependence between culture and language: if a language disappears, the culture described and supported by this language does too, and visa versa. This means that language and culture not only have cause-effect relation, but there is a duality, a compulsory interpenetrating interdependent simultaneity of language and culture existence, as well as their synchronous interdependent development and extinction.

In spite of the apparent simplicity of the notion of hierarchy, each culture has its own hierarchies, which are the most typical and can characterize each culture in the “overcultural” or intercultural space. This is the evidence of cognitive relativity, rationality and clarity (CRRC), which reflects utmost sensitivity in building different hierarchies in different contexts, including the subjective perception (logical-gnosiological, subjective-dialectical aspect). An example of this is an expanded conceptosphere of “snow” for the Eskimos and of “horse” for the Turkish-Tatars [also see 6, 7].

The report characterizes the notion of hierarchy in the Tatar language from two points of view: as an object and as an instrument.

On the one hand, it is interesting to study the Tatar language as a phenomenon which enters together with other natural languages (NL) into the world system and world outlook as an object with a complex structure and functional, a mechanism of cognitive, communicative and technological destination. Such a research reveals general and particular phenomena in the language, analyzes the existing categorial system upon its completeness, sufficiency, redundancy and correctness by comparing it with analogical phenomena in other languages, and also using the electronic corpus of Tatar texts.

Indeed, like many other languages, the Tatar language is characterized by a precise interposition of an object, a subject group and a verb group in the form of SOV (Subject-Object-Verb), as opposed to Indo-European languages (especially the English language) with an SVO type of subordination. Multi-faceted analysis of such a difference in the language hierarchy on the highest, structural level could be a subject of an independent research. Partly, some ideas on this topic are expressed in the work [8]. For most language groups a hierarchy is defined as a hierarchy of linguistic levels, according to which all the linguistic phenomena can be distributed among several levels. The Big British Encyclopaedia also defines the hierarchy of levels (layers) of the language. At the same time there are discrepancies among specialists. Some define the hierarchical structure of levels as phonological < morphological < syntactical < semantic, others as phonetic < phonological < morphological < lexical < syntactical < semantic or some include only three levels in the hierarchical structure: phonological < morphological < syntactical, manifesting that the semantic aspect is present in each of the three levels, hence semantics reveals itself in the context of each of them. This controversial situation regarding understanding and description of language levels is also discussed in the report.

On the other hand, alongside with investigating the language in a system of languages, it is important to study the potential of a natural language as an instrument of the world cognition and forming when: 1) identifying the problem area, the corresponding object and subject of research (classifying and selecting, clustering and correlating), 2) conceptualizing the problem area (differentiating significant notions and relations among notions, including the hierarchical ones), 3) specifying the received conceptualization (describing notions and their relations by means of the language).

The identified world presents a conceptualization of the reality which has a complex hierarchical structure. Therefore, the more naturally and adequately the world is described by some natural language, the more correct are decisions made in this world. So investigating and describing the Tatar language from the point of view of presence of means and mechanisms (lexical and grammatical) for realization of natural conceptual and structural phenomena in some context (semantics, “a deep meaning”, “a model of the world” described by the text) is very important. In the Tatar language there are special means on the morphemic level (case affixes -DAGY, -NYKY describing recursion) giving hierarchy in the paradigm, and also in syntagmatics (case affix of belonging –NYN’, the order of affix categories in corresponding types of lexemes – parts of speech) [8], which will be discussed by the author of this paper in his report, illustrated with examples.

The etymology of the notion of hierarchy is also of special interest. From the point of view of the author of the paper, the translation of the word “hierarchy” from Greek as “holy power” and its usage in the science in the meaning of “service stairs”, subordination by the inferior to the superior [9], narrows the essence and methodological potential of this complex ontological notion of structural perception of the world which fixes order in a complex multilayer multistage world.

The conception of hierarchy as a certain order of “submission of the inferior to the superior” is only one of the aspects of world organization and the reflection of one type of order included into the complex notion of hierarchy, which has a form of a consecutive co-governance, determining the interrelation and interdependence of notions and phenomena vertically and horizontally in the spatial perception of the world. In the report the author offers his interpretation of this notion basing on the Tatar language as one of the Turkish languages that have deep historic roots, as it is well-known. This interpretation parts from the translations of the world "hierarchy" from the Tatar language as a combination of two words "ier" – "shoal, flock" (a form of dynamic organization of a numerous group of some creatures, for example, "a shoal of fish") and "arca" – "back" (a supple deflecting oblong form; in the Russian language fixed as a geometrical form: a salient bow-shaped figure, such as an "arch above columns").

In conclusion the methodological and practical actuality and perspectives of studying a language as a hierarchically organized semiotic system need to be mentioned. First of all, it introduces more order and clarity in the solving of the problem of natural languages classification, including a language into this or that class, into this or that related group. Secondly, it is important for rational, correct, most complete and adequate description of a language, based on the potential of the language itself, on the collection of linguistic phenomena and on quite a full electronic corpus of the language, but not just on the example of grammatical and lexical structure of other languages.

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N-tuple Algebra: Providing Clarity by Combining Logical Inference with Defeasible Reasoning

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Abstract: *The study describes new capabilities of N-tuple algebra (NTA) belonging to the class of Boolean algebras and developed by the authors as a theoretical generalization of structures and methods applied in intelligence systems. NTA supports formalization and solving a wide set of logical problems (abductive and modified conclusions, modelling of graphs, semantic networks, expert rules, etc.). Here we mostly focus on unified implementation of logical inference and defeasible reasoning by means of NTA. In NTA, reasoning procedures can include, besides the known logical calculus methods, new algebraic methods for checking correctness of a consequence or for finding corollaries to a given axiom system. All NTA reasoning techniques have clear interpretations within classical logic.*

Keywords: data processing; knowledge representation; intelligence system; flexible universe; *n*-ary relation; general theory of relations; *n*-tuple algebra; logical inference; defeasible reasoning

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State of the Art. At the previous conference (Kulik et al., 2010a), we introduced *n*-tuple algebra (NTA) that uses Cartesian products of sets rather than sets of elements (elementary *n*-tuples) as a basic structure and implements the general theory of *n*-ary relations.

Novelty of our approach is that we developed some new mathematical structures allowing implementing many techniques of semantic and logical analyses; these methods have no analogies in relational algebra and binary relations theory.

A practicable logical analysis should include both *deduction* (logical inference) and *non-deductive analysis techniques,* i.e. analyzing uncertainties and inconsistency, as well as forming hypotheses and abductive conclusions. Convenient formal methods of the classical logic provide solution of the deductive tasks only, with some problems arising nonetheless. Other mentioned tasks commonly involve non-classical logics, in particular, the default logic and non-monotonic logics. It is not easy to combine logical inference and non-deductive reasoning within the formal approach. Our general theory of relation provides some possibilities to merge deductive and defeasible analyses.

A.Thayse (1988) defines defeasible reasoning as an opposition to "strongly correct" reasoning. Defeasible reasoning is used when we deal with incomplete, inexact and/or changeable initial information. Non-monotonic and default logics are special cases of formalization for such kinds of reasoning. Conversely, we should also consider methods of modeling and analyzing based on classical logic and suitable for defeasible reasoning. We propose using NTA for this purpose since it unifies solving a wide set of logical problems (Kulik et al., 2010a; 2010b). Below we will focus on performing logical inference and defeasible reasoning by means of NTA. The given paper does not concern inductive methods of logical analysis though they are a part on non-deductive reasoning. We have not completed our research on implementing such methods in NTA yet.

Size limits of this paper let us only refer to some of our related works.

1. NTA: Logical Inference Techniques

Logical inference systems often use two theorems introduced and proved in (Chang & Lee, 1973). They are reproduced below since they justify algebraic methods of logical inference.

Theorem 1. Let formulas $F_1, ..., F_n$ and G be given. Then G is a logical corollary of $F_1, ..., F_n$ if and only if the formula $((F_1 \wedge ... \wedge F_n) \supset G)$ is a valid one.

Theorem 2. Let formulas $F_1, ..., F_n$ and G be given. Then G is a logical corollary of $F_1, ..., F_n$ if and only if the formula $(F_1 \wedge ... \wedge F_n \wedge \neg G)$ is inconsistent.

Logical inference in NTA is based on the theorems 1 and 2. Using correspondences between NTA and predicate calculus, these theorems can be expressed in NTA terms as follows.

Method 1. Let NTA objects $F_1, ..., F_n$ and G be given. Then G is a logical corollary of $F_1, ..., F_n$ if and only if $(F_1 \cap_G ... \cap_G F_n) \neq \varnothing$ and $(F_1 \cap_G ... \cap_G F_n) \subseteq_G G$.

Method 2. Let NTA objects $F_1, ..., F_n$ and G be given. Then G is a logical corollary of $F_1, ..., F_n$ if and only if $(F_1 \cap_G ... \cap_G F_n) \neq \varnothing$ and $F_1 \cap_G ... \cap_G F_n \cap_G \overline{G} = \varnothing$.

Here and below $\cap_G$, $\cup_G$, $\backslash_G$, $\subseteq_G$, $=_G$, etc. denote *generalized operations and relations*, i.e. operations and relations with preliminary transformation of attributes in NTA objects. They are similar to corresponding operations and relations of algebra of sets (Kulik et al., 2010a; 2010b).

Thus, deducibility in NTA is based on inclusion or emptiness checks for NTA objects rather than on inference rules. Compared to theorems 1 and 2, methods 1 and 2 contain a precondition $(F_1 \cap_G ... \cap_G F_n) \neq \varnothing$, which eliminates situations corresponding to the Duns Scotus' law (the law of denial of the antecedent): falsity implies anything. In specific logical systems, where degeneration of premises causes no problems, this precondition is not obligatory.

Suppose that we have a system of axioms $A_1, \ldots, A_n$ represented as NTA objects. Let us describe methods for solving the following two problems through NTA.

1) *Problem of correctness check for a consequence.* If we have an alleged consequence B, the proof procedure is a correctness check for the following generalized inclusion:

$$(A_1 \cap_G ... \cap_G A_n) \subseteq_G B. \quad (1)$$

This relation allows for correctness checks not only for the inference rules of classical logic, but also for rules specific to a certain knowledge system (Kulik et al., 2010b).

2) *Problem of derivation of consequences*. In order to solve this problem, we first calculate an NTA object $A = A_1 \cap_G \ldots \cap_G A_n$, then we choose a B_i for which $A \subseteq_G B_i$ is true. We have developed special techniques that allow to find all possible corollaries of a known A using the relation (1).

2. Defeasible Reasoning in NTA

2.1. Collisions in Reasoning

In order to eliminate existing discrepancies between formal logic and natural deduction, we propose a concept of *collision*. Collisions mostly occur during defeasible reasoning when a new knowledge or hypothesis is included into a logical system. They indicate violations of some formal rules or restrictions that control consistency or meaning content of the system. Within the systems with defeasible argumentation, collisions generally correspond to the terms "rebutting", "argument undercutting", "counter-evidence (attack)", etc. The term "collision" was initially used by B. Kulik for analysis of syllogistics-like reasoning, where two kinds of formal collisions are defined, namely:

a *paradox collision* arises if premises infer a statement like "No A are A" ($\overline{A} \subseteq A$), that is, the volume of the term A is empty;

a *cycle collision* occurs when the relation $A \subseteq B \subseteq \ldots \subseteq A$ can be deduced from a system of sets; this means that the terms contained in the cycle are equal.

The listed collisions can be detected without taking the subject domain into account, this is why we named them *formal collisions*. The third kind of collisions is not a formal one; it features a situation when some consequences do not match some indisputable facts or justified statements. We call this collision an *inadequacy collision*.

Unlike a logical contradiction which expresses an absolute degeneration of premises, collisions can have opposite interpretations in different cases, i.e. they are semantically dependable. For example, within one system the equality $A = \varnothing$ means an absence of the object that is necessary for existence of the system, and in another system this equality specifies a status of the object A. The first case requires changing the premises while the second case provides a new useful datum.

2.2. Analysis of Hypotheses

NTA allows for a formal definition of hypotheses. Let us suppose that a system of premises expressed as NTA objects $A_1, \ldots, A_n$ is given and the NTA object $A = A_1 \cap_G \ldots \cap_G A_n$ is calculated.

Definition 1. A certain formula H is called a *hypothesis*, if $A \subseteq_G H$ is false. Here, we assume that the hypothesis is a premise or an axiom.

Otherwise, H is a consequence according to (1). Consequently, H can be considered as a first approximation hypothesis, if $A \setminus_G H \neq \varnothing$. For the second approximation, we need to check correctness of the hypothesis. The hypothesis is correct if the object $H \cap_G A$ contains no collisions.

Forming and checking of hypotheses usually accompany other analysis methods for defeasible reasoning. Below, we will describe the use of hypotheses in searching for abductive conclusions.

2.3. Abductive Conclusions

Abduction is a forming of an explanatory hypothesis when we know some of the premises and an estimated consequence that is confirmed with facts or reasonable arguments, but a formal check does not infer it from the given premises. For example, abduction is used during diagnostics.

Definition 2. If B is an estimated consequence of the premises $A_1, \ldots, A_n$ and the statement $A \subseteq_G B$ is known to be false (once again, $A = A_1 \cap_G \ldots \cap_G A_n$), then a formula H is an *admissible abductive conclusion* when the two following conditions are met:

i) H is a hypothesis (i.e. $A \subseteq_G H$ is false) and $H \cap_G A$ is not empty;

ii) $(H \cap_G A) \subseteq_G B$, that is, adding H into the system of premises results in deducibility of the estimated consequence B.

Definition 3. An admissible abductive conclusion is *correct* if $H \cap_G A$ contains no collisions.

A search algorithm for abductive conclusions is described in (Kulik et al., 2010b).

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Combining Neural Networks and Incremental Techniques for Coordination in System of Systems

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Abstract: *In this paper, we introduce a combined approach to modelling, analysis, monitoring and operative control of structural states of a System of Systems functioning in uncertain multi-criteria environment. In order to design and reconfigure objects of this kind, we use structure dynamics control and genome methods. To monitor and support right performance of such systems in comparatively stable environment, we apply a combination of a game-theoretical approach and an incremental coordination technique developed by authors for multipurpose systems. Results of a very simple case study implemented by simulation confirm our theoretical concepts.*

Keywords: incremental coordination; stability limits; situational modeling; structure dynamics control

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Problem Setting. After designing an acceptable configuration of a System of Systems (SoS) and its performance startup, SoS managers face the problem of controlling and providing a proper level of the SoS efficiency at quite possible changes of inner parameters and/or external factors influencing the system. If these impacts are drastic, a reconfiguration of the whole system is needed. We have some ideas regarding the reconfiguration as well (Pavlov et al., 2011), but in this study we will dwell on how to improve functioning of a SoS under comparatively small disturbances of various origin, which we can compensate to an affordable extent without changing the current SoS structure.

1. Modelling Software

To acquire any practicable results, SoSs have to be modelled as complex spatial dynamic systems with variable structure, multiple inner and outer links. So, first we developed a suitable modelling environment (Sokolov & Fridman, 2009; Sokolov et al., 2010) within the frames of Structured Analysis and Design Technology (Yourdon, 1989). This software system provides for state analysis of systems described according to the General Systems Theory (Mesarovic & Takahara, 1975).

2. Theoretical Basis

As any SoS usually includes several decision makers (DMs) with peer ranks, we need an instrument to objectify and compromise their preferences. We had discussed some general ideas of such compromising in (Gorod et al., 2010. Since then a new direction for our research was found in interpretation of the operative management as a coordination problem.

Our idea of SoS operative management is in coordinating interactions among lower-level DMs during the time intervals between SoS structure reconfigurations. We considered two possible bases for the coordination, namely game theory (Fridman et al., 2011) and gradient methods (Fridman & Fridman, 2010). Each of them is preferable for proper conditions. Game theory fits with systems working under deliberate counteraction or feedbacks corruption. If none of these is present, game methods result in too "pessimistic" decisions. Gradient techniques are simpler to implement, but they need fairly good feedbacks. The problem is that it is not easy to determine the quality of feedbacks in real systems.

Like in (Mesarovic et al., 1970), we consider a three-level system where the lowest level has a hierarchical or network structure, and the second level consists of locally informed control blocks (DMs); each of these blocks controls one of the lower-level systems. The coordinating block (the Coordinator) is on the upper level and can access any necessary information from every lower element (Fridman & Fridman, 2010). Every DM and the Coordinator have a specific general quality criterion depending on several scalar criteria. The Coordinator sends adjusting parameters to DMs and receives feedbacks from local DMs. Lower-level systems may interact, but DMs receive information from their subordinated systems only.

3. Coordination by Means of the Game Theory

To provide functioning of systems with elements whose preferences can differ, the preferences need some coordination (Mesarovic et al., 1970). In (Fridman et al., 2011), the authors formulated a sufficient condition for game-theoretical coordinating of the DMs' preferences. Under this condition the Coordinator can provide a mode when all lower-level DMs send values of their goal functions belonging to the set of effective decisions back to the Coordinator in reply to its every control impact. The developed coordinating procedure assures a generally optimal decision within sets of Pareto-optimal decisions for the local problems.

4. Incremental Coordination

The developed coordination technique is based on the necessary and sufficient conditions of coordinability for a locally organized hierarchy of dynamic systems (Fridman & Fridman, 2010) containing several DMs with peer rank. It is impossible to directly determine their decisions; that is why the whole network is a System of Systems. Similar interconnected and collaborative networks appear when a virtual enterprise is established (Sokolov et al., 2010). To coordinate such structures on intervals between reconfigurations, we propose usage the criterion initially developed for classification of situations (Fridman & Fridman, 2007). We have proved that the whole system will be coordinated, if the Coordinator can choose all adjusting parameters it sends to the DMs so as the gradient (increment – for discrete systems) of its generalised criterion on its current dominating scalar criterion has the same sign with all gradients of the Coordinator's criterion on current dominating scalar criteria of local DMs (Fridman & Fridman, 2010). The proposed sufficient conditions of coordinability resemble the ideas for providing stability of local controls in groups of automata described in (Stefanuk, 2004) where it is necessary to have positive partial derivatives of a general criterion on input parameters of a corresponding element of the group.

5. Simulation as a Case Study

The incremental coordination technique was exemplified by coordination of a simple linear network object (Fridman & Fridman, 2010). Inputting of coordination signals according to the proposed algorithm improved convergence of real and ideal trajectories (lowered asymptotical errors) by several times. As for stability ranges, they became even wider that they had been after successive application of local control signals. This can be interpreted as a substantiation of efficiency of the developed coordination technique. However, a drawback of this method is in subjecting all DMs a disturbance from the Coordinator any time another DM produces a wrong feedback. To prevent this effect, we developed a neural network responsible for determining an initial source of any disturbance earlier than this disturbance has spread all over the rest part of the SoS. Then the Coordinator can adjust only its impact on the certain DM controlling the corresponding node of the SoS. This way we protect other DMs from unnecessary decisions and minimise disturbances in the whole SoS.

6. Conclusion

We propose the following technique for combined application of our game-theoretical and gradient approaches to solve the problem under discussion. For the first step, we apply the incremental coordination. If the feedbacks from the lower level do not decrease to a required extent in a certain period, the Coordinator detects a deliberate counteraction and changes the coordination algorithm for the game-theoretical one. We believe this approach provides a specific constructive way to consider contexts (Bianco & Ezhkova, 1994) in some SoSs.

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Representations and Compressions

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Abstract: Change results from cause, and cause is the subject of explanation. Two types of explanatory models are often evoked as the context underlying change. Models based on labels and categories we shall refer to as "representations." More complex models involving stories, multiple algorithms, rules of thumb, questions, ambiguity we shall refer to as "compressions." Both compressions and representations are reductions. But representations are far more reductive than compressions. Representations can be treated as a set of defined meanings – coherence with regard to a representation is the degree of fidelity between the item in question and the definition of the representation, of the label. By contrast, compressions contain enough degrees of freedom and ambiguity to allow us to make internal predictions so that we may determine our potential actions in the possibility space. Compressions are explanatory via mechanism. Representations are explanatory via category. This paper highlights the risk, which occurs when we confuse the evocation of a representation (category inclusion) as the creation of a context of compression (description of mechanism). In the drive for efficiency such substitutions are all too often proclaimed – at our peril.

Keywords: representations; compressions; change; explanation; cause; coherence; ascription; experience; language; models; affordances; context; category; label; mechanism

When we perceive the world as coherent, as holding together and as making sense, we have the ability to assume our situation, and 'to get on with things'. Simple models can be many a manager's undoing. Managers are trained to act on simplicity, but that simplicity is opposite to the complexity of the world in which such businesses operate. Both complexity and simplicity offer paths to success - but those paths are very different. Complexity threatens the managers' notion of coherence. When our perception of coherence is shattered; the world no longer seems to hold together. Things do not make sense. We continually have to ask questions and we worry about our inability to find answers in which we can believe. We react to our loss of assurance with a loss of self-confidence; we pull back to whatever coherence we can find.

Our "modern" world has found great efficiencies in the ascribed coherence of rules and algorithms. Efficiency has its place but it also has its price. Efficiency it seems can be the enemy of resilience. Category based explanations may be efficient but they are not resilient. Resilience requires: narratives not labels, mechanisms not categories, a focus on experience and not on labels and a need to be aware of when representations work and when they fail. We need to become aware of the complex role of both representations and compressions in defining the possibility space, in allowing for the overt recognition of affordances, and in challenging the experience of coherence as life itself unfolds. Representations have little capacity for dealing with complexity. In the assertion of category as explanation context is all too often ignored. Yet context is key to any understanding of mechanism.

The mistake is one of ascribing a label (attributing cause to category) when identity is undetermined, uncertain and undefined (which instead suggests a need to identify mechanism). Only if one has well-earned confidence in one's descriptors does it make sense to use them to analyze a situation. Metaphors and analogies may be fascinating and tantalizing, but they are very uncertain and questionable. If one wants to 'model' a situation one needs to be sure of the definitions, identities and terms of use one is making use of. No such epistemic care is normal in business. Labels are all too quickly assumed to be accurate depictions of reality. The complexity reduction method is to substitute an indexical (a placeholder) where either model or context demands an individual. Such a casual reference to indexicals -- in situations where the models and their use demand individuals (i.e. situatedness and context dependence) -- results in the replacement of a strong homological relationship with a weaker analogical one. It is this replacement - of compressions with representations --which my contribution will call into question.

It seems there are two kinds of coherence in the world. Ascribed, measured coherence focuses on how well a given item, person, situation etc. matches the assigned label. It also examines how well rule 'x' matches desired outcome 'y'. The underlying assumption is that the pairing of label 'x' and rule 'x' will produce desired outcome 'y'. But, label based rules are not the only kind available to us. The traditional craftsman's apprentice spends years observing the master at work with two objectives: to gain awareness of what is contextually possible and to develop a repertoire of activities to make use of those possibilities. Aircraft pilots undergo hundreds if not thousands of hours of (simulation) training with much the same objective -- though their task is to recognize dangers that may present themselves context by context, and to develop a repertoire of reactions to these dangers. Both the craftsman's apprentice and the pilot do not learn their skill from the study of label-based rules. Instead they are required to engage with experience and to learn from context. In a recent work (Letiche & Lissack, 2011) Hugo letiche and I call this experienced coherence.

Table 1 below illustrates the implications of these two kinds of coherence seeking behaviors – ascribed coherence (agreement with label) and emergent or experienced coherence (agreement with present context)

Characteristic	**Ascribed Coherence (Agreement with Label)**	**Emergent Coherence (Agreement with Present Context)**
Reaction to "Many"	**Complicated unfold**	**Complex – observe weave**
See Pattern	**Provide a Label**	**Observe Affordance**
Adjacent Possibles	**Predict**	**Explore**
Weak Signals	**Reject as Noise**	**Investigate for Resonance**
Multiple Signals	**Frame/ Bracket**	**Dialogue Amongst**
Multiple tasks/roles	**Compartmentalize/deny**	**Awareness of active role playing**
Role in a Conversation	**Speak**	**Listen**
Tone in Conversation	**State Facts**	**Ask Questions**
Focus of Efforts	**Efficiency**	**Resilience, Creativity**
Inspiration	**Machine**	**Environment**
Type of Speech Act	**Monologue**	**Dialogue**

Table 1

When we use representations, labels, categories, and codes we have a tendency to demand coherence (a unity or oneness) between the situation, people, process etc. to which we are applying the representation and our understanding of the meaning of the representation itself. (That demand for coherence is the focus of the much of the literature on the subject c.f. Thagard, 1992, 2000.) When we observe a mismatch between our understanding of the representation and the target of our use we seek to demand a correction (see Mori, 1970, 1982). Ascribed coherence and experienced coherence describe very different kinds of "matches" and "mismatches."

Labels and categories eliminate the individual variations of specific items. The substitution of the label for the thing itself thus simplifies the world. Labels form a very valuable role in limiting the world. Instead of actively discussing the multiple approaches which may all be interpretations, enactments, decodings, or embodiments of a model, managers often act as if there is but one or perhaps two decodings. These "privileged" interpretations are given status as names, labels, or symbols -- and the labels are then used as guides for action.

Here is where the risk occurs. The language we each use to describe our surroundings predetermines what we 'see'. As Kuhn (1962) put it: "You don't see something until you have the right metaphor [model] to let you perceive it." Or as suggested by Srivastva and Barrett (1988), naming implies anticipations, expectations, and evaluations toward the named. By making assumptions (and in so doing restricting ourselves to a particular or one method of decoding) we predetermine what might be learnt, which will limit the options that appear to be open to us as managers. This is because by adopting a particular perspective, and therefore making particular assumptions, we limit what we can 'see'. The perspective acts as a lens that only allows particular features to come into focus - all other features are lost, or assumed not to be relevant to the problem at hand. Furthermore, in communicating with others by making use of a particular viewpoint we limit their ability to 'see' what is relevant.

To supplement this tendency we need to stop making lists of labels and categories. Instead we need to outline the ingredients for dialogue surrounding the situation, idea, or context we seek to address. We can do this by making use of the dialogic square. We can do this by emphasizing the need to consider the DIS-similarities evoked by analogies and metaphors. WE can do this by remembering that representations are NOT enough, that we need to be making use of models which involve compressions if we expect to capture enough of the complexity around us so as to preserve our resilience.

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On a Subjective Control of Safety Level

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Abstract: *Factors influencing laymen's feeling of danger are not results of any sound reasoning, which is characteristic of experts. Cognitive psychology has discovered heuristics typical of the way of thinking of everyday people. It can be stated in general that laymen's feeling of danger is usually realistic. It often proves to be a better assessment of risk than expert opinion is on the same subject. Moreover, in a democratic society laymen's opinion cannot be neglected: their taxes form the main financial resource of public investments and they must bear the negative consequences of wrong decisions. In the present paper we show how one can assess a subjective feeling of risk, and to base on it an acceptable safety level*

Keywords: subjective risk assessment; cognitive rationality; cognitive relativity; cognitive clarity

1. Introduction

While judging a risk situation laymen recall the set of unfavourable events stored in their memories rather than taking the set of objective facts. This heuristics is known in cognitive psychology as "availability", see Simon (1983). Despite its evident lack of perfection this heuristics delivers often a better estimation than expert opinion.

This problem has classical solution methods, belonging to the scope of decision theory. In all such methods however points of view of the decision-maker (risk awareness, empathy, profit) have an almost exclusive role. The solution proposed by us has the advantage that it makes possible for the decision-maker to consider public opinion even in cases when a public opinion poll is not possible.

2. A measure of individual risk

In this section we build up a model describing how the change of risk depends on the change of occurrence probability of the risk event.

We simplify time scale by discretising it, i.e. the length of a time interval can only be the nonnegative integer multiple of a given length.

Following a partly similar reasoning in Chow *et al*. (1988) Ch. 13, and Benedikt *et al*. (2002) we suppose to have a sequence of time intervals. In each interval a risk event can occur with probability *p*, independently of what has happened in previous intervals.

Then the number of intervals elapsing until the first risk event and the number of intervals elapsing between two consecutive risk events has the same geometric distribution. All have the same distribution parameter p. The expected value of this distribution is $1/p$. So the expected number $\tau = \tau(p)$ of intervals elapsing until the first or between two consecutive risk events is:

$$\tau(p) = \frac{1}{p} \qquad (1)$$

This is an objective degree of individual safety for a person who faces the given risk event.

3. Perspective view of time

As it was discussed in Benedikt et al. (1999), time elapsed since the last occurrence of the risk event, denoted by t, as mental stimulus can be handled by the following formula where the feeling of safety, denoted by $S(t)$, is the response.

$$S(t) = \ln t + 1 \tag{2}$$

Actually, this is the Fechner-Weber (F-W) physiological law, where we choose an appropriate time unit. Its application is justified for mental situations. The same formula holds if *t* denotes the time elapsing until the first occurrence of the risk event in the future. (2) reflects the fact justified by psychological experiments that people look at past and future risks in a "perspective" way. This means that the farther is the risk event in time, the less it worries people. "Farther" can be understood for both the past and the future, depending on whether we have factual data relating to past or theoretical data relating to future risk events.

Application of the F-W law for mental responses is supported by descriptions of human intellectual processes, well known in cognitive psychology. These are the heuristics of “fixation and adjustment” (we adjust our own subjective perception of subsequent numbers to the number noticed first), see Tversky & Kahneman (1988).

4. Subjective risk assessment

We apply the F-W principle for the risk perception situation. Starting from (1), we observe that $\tau(p)$ expresses actually the length of a time interval; therefore we may apply (2).

$$S(\tau(p)) = \ln\tau(p) + 1 = \ln\frac{1}{p} + 1 \tag{3}$$

Suppose that there are N similar sites where the same risk event may occur independently of the other sites. Then p^N is the probability that the risk event occurs on each site in the same time interval. Hence according to (3):

$$S(\tau(p^N)) = \ln\tau(p^N) + 1 = \ln\frac{1}{p^N} + 1 \tag{4}$$

From (1) it follows that the reciprocal of the average riskless time period is the probability parameter of a geometrical distribution producing the same average riskless time period. Consequently, we can conceive $1/S(\tau(p^N))$ as a probability. This probability relates to the joint occurrence of N independent risk events, e.g. at N different risk sites which are all alike. From this we can conclude that the probability of one such event is

$$f(p,N) = \left(\ln\frac{1}{p^N} + 1\right)^{-1/N} \tag{5}$$

$f(p,N)$ expresses the perceived average occurrence probability of N independent copies of the same risk event (“average” means here geometric average, because the events are independent). This function was earlier analyzed in Benedikt (1992) and it was found that

$$p < f(p,N) < 1 \tag{6}$$

$$f(p,N) \nearrow \infty \text{ when } N \to \infty \tag{7}$$

$$\lim_{p\to 0}\frac{f(ap,N)}{f(p,N)} = 1 \quad \text{for } 0<a<1 \tag{8}$$

(8) means that the smaller risk probabilities actually are, the less we can distinguish among their effects on frequencies of occurrence. This is absolutely in accordance with the fact that a person having no mathematical expertise cannot feel the difference between two different orders of magnitude.

It is now easy to illustrate the expressive meaning of $f(p,N)$ through a simple example. Suppose that we have a dangerous site (e.g. a nuclear power station, a dam, a chemical factory etc.) with an occurrence probability p of the risk event. The nearby population knows that there are altogether N similar sites, N-1 sites thereof are elsewhere, but the population knows about them. Now the fear that the risk event occurs on our site corresponds to $f(p,N)$ rather than to p, although the risk events on different sites are statistically independent. Nevertheless, since there are news about the existence of similar sites, the fear induced by the possible occurrence of the risk event on other sites has an unjustified association to the given site. Conversely if an engineer uses $f(p,N)$ as a design safety parameter instead of p, this will correspond much better to the risk feeling of the population concerned. A higher level of perceived safety is attained by a higher N value, so N expresses the degree of subjective safety level. (This point was analyzed earlier in a different way in Szász *et al*. (2010)). So we can see here the principle of Cognitive Rationality, see Ezhkova (2004).

Defence against a risk event of higher supposed risk probability means a higher safety level in safety oriented computations. Therefore the higher is N supposed by the public and thus reckoned with by safety experts the higher will be the safety level. That is, if more risk sites are known by the public then a higher risk probability will be supposed and hence a higher safety level will also be required. If we accept this hypothetic dependence of events and reckon with it, then we can decrease the chance of conflict between experts' and laymen's risk perception. So we can see here the principles of Cognitive Relativity and Cognitive Clarity, see Ezhkova (2004).

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Is Macroeconomy a Self-Organising System

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Abstract: *We have experienced several recurrent economic crises originated from the financial systems during the past thirty years the latest being banking crisis escalating from USA, Lehman & Brothers bankruptcy 2008. The economical reasons behind these financial and banking crises and even system failures have been investigated and identified quite thoroughly. Broadly thinking the common denominator has been abundant money supply and uncontrolled credit expansion. What is less known are the factors, which led to the catastrophic behaviour in the financial system. Somehow the decision making process must have been distorted which has led to disconnection from the common realities. We may say in more precise way that cognitive relativities, rationalities and clarities influenced these changes.*

Usually societal systems like economy is goal oriented and based on the assumption that all the actors are making decisions objectively rationally. This is without doubts an extreme assumption because decision makers have more than one context and framework within the decisions are made. Politician may prefer the opinions of the supporters rather than expert evaluations etc. Different decisions could be considered rational in some relevant context. It could be assumed that there would be in existence of some kind of statistically proved rationality. However it could be not easy to find out what this rationality may be while there have appeared severe economic imbalances and non-optimums practically in all the most developed countries. This indicates that there must have been continuous systematic false reasoning within the macroeconomic decision making while observing it from the position of the statistical rationality. Speaking in terms of cybernetics their decisions can disturb the self-organizing mechanism of the macroeconomic system.

Keywords: equilibrium; self-organizing; cognitive system; financial crisis; indebtedness; compexity

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Artificial Intellectual Hand: Capture Reliability Prognosis of Non-Oriented Complex Shape Objects for Manipulating Robotics

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Abstract: *There is the actual unsolved problem in manipulating robotics and human artificial limbs – CAPTURE RELIABILITY OF NON-ORIENTED COMPLEX SHAPE OBJECTS – as the necessary stage of any object manipulating - since XX century. The main reason of existence of that problem is the absence of some active forces of new contact points in system " HAND - OBJECT" ("H-O") - such weight force projections before object raising due to physical laws, and so obligatory appearance of these forces during the object manipulating what can change physical situation in system "H-O"(after object raising). It generates paradoxical situation when at first it is necessary to take decision (by robot or man) on capture reliability in initial conditions before object raising but then realization of the decision takes place in another conditions. Above mentioned is seen in different equilibrium conditions of result interaction of (stable, non – stable) contact point forces in system " H-O " as the effect of real physical situation as the insufficient information support of manipulating robotics. Biologists consider that possibilities of mammals to prognosticate situation developments by evaluations of future events have provided their domination among birds, reptiles and etc on our planet. Obviously well-known possibility of human transition from primitive levels of prognosis to high levels of ones could contribute, first of all, human domination among the rest of mammals. Well-known main human activities are connected continually with the results of another kind of human activities in other words - determination of natural surroundings discovered the semantic component of initial information. Typical properties of those activities have subconscious, forced and constant characters in different starting conditions. If adaptation to unknown object complex shape (as topological task) can be realized, for instance, by application of robot technical vision system and adaptive gripper, so capture reliability of that object (as physical task) has no cardinal decision. In addition dominant numeral methods of modern control systems of manipulating robotics and of artificial limbs deprive these techniques the possibility to apply the internal relations by signs of indications of capture reliability. Therefore manipulating possibilities of any robot connected with capturing object can be realized successfully only in shot frames of beforehand created or estimated (by man) determinate conditions. The strategy of problem cardinal solving connected with bionic-like approach on the basis of application formalized interdisciplinary knowledge – biology, physics, cybernetics, semiotics, informatiology, linguistics, robotics and etc - the essence of artificial intellect – with technical simulation of:*

The structure of human functional system – the gripper system (Theory of Functional Systems) in indeterminate condition, including simulation of spatial sense of touch of human hand with forming and estimation tactile image of fixing virtual displacements of object (image F.V.D.O.) what, as bottom line, can be seen in prediction of activity result.

Functional principles of movement act of human arm discovered during the experiments in similar conditions.

As a whole, by simulation of intellectual processes on the level of decision taking as well as simulation of realization processes of that decision on behaviour level.

That provided to take decisions on the two following tasks before object raising:

The determination of the physical situation in system "H-O ".

The prognosis of the capture reliability of non-oriented complex shape object (after object raising) as a stable equilibrium condition of result interaction of different forces in contact points system "H-O ".

Keywords: capture; reliability; prognosis; manipulating; robotics; non-oriented; complex; shape; object

1. Determination of the Physical Situation in System "H-O"

The first task solving is based on using *geometrization* of the physical component of initial information in system "H-O" on semantic level, which is capable to ensure the transition of semantic information component from physical task with indeterminate conditions to geometrical task with determined conditions due to discovering the semantic component of initial information, changing information status from “Closed” to “Open“ for our mind.

Above mentioned is based on using following *semiotic structure of relations* of contact points as *symbiosis of informatiology* discovering geometrical relative multi-agent foreshortening of indeterminate situation and *semiotics* discovering semantic component of information:

1. *Indication* – relative non-dimensional contact point position.

2. *Internal connection* – connection of the first and the third components of the structure as the result formalized descriptions of knowledge.

3. *Semantics* – the essence of result of interacting contact point forces as semantic component of information.

The semantic component of information of image F.V.D.O. on elementary level is the pair of anti-vector of forces of any contact point.

Formalized descriptions of interdisciplinary knowledge have discovered *the connections* between relative positions of contact points and the section of F.V.D.O. During passive adaptation gripper to object’s shape every new contact point can generate own quantum (group) of different interval *relations* between the point and other earlier appeared ones. Essentially, the multitude of interacting contact points – the base of multi-agent system creating these relations – is the base of semantic net of relations. It can generate the conditions for classification of the relations by control system.

So it is possible to create the geometrical constructions of sectors of fixed virtual object displacements in space – the base of image - like representation of semantic component of real physical situation in system “H-O“ (before object raising):

$$IntR(a_i;a_j) \Rightarrow \{f_i^a\}^n \cap \{f_j^n\}^n \Rightarrow \{e_{(i)}^{\,3}\}^m \Rightarrow \Delta\,\Phi^n_{(\alpha;\beta)}$$

$$C_3\{A_3\,(IntR(a_i;a_j))\}^N \Rightarrow \Phi_{об}^N$$

f_i^a ; f_j^n – - Virtual vector forces in points ***ai,aj***

$e_i^{\,3}$ – - Single geometrical vector F.V.D.O

$\Delta\,\Phi^n_{(\alpha;\beta)}$ - Sector F.V.D.O. of relations and its parameters

N - Quantity of contact point connections

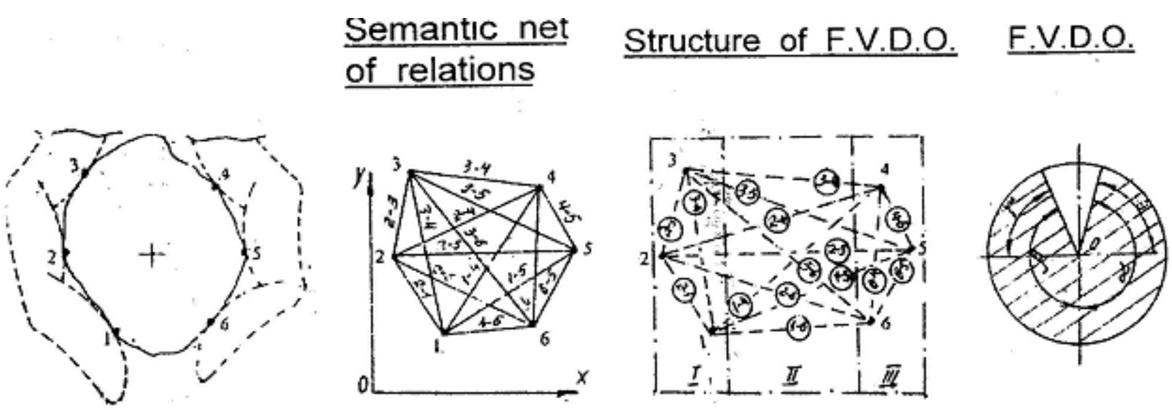

Figure 1: Structure of fixing virtual displacements of object (image F.V.D.O.)

2. Prognosis of Capture Reliability

The second task solving is based on analysis and estimation of image F.V.D.O. with classification of its connections in comparison with the image of complete cinematic locking of object (C.C.L.O.) - as the aim then determinate their deviations, classification the deviations on permissible and non-permissible ones – the basis of prognosis of capture reliability.

There is *the structure of information tool of capture reliability prognosis of non-oriented complex shape objects* for realization these activities, including the following components:

1. Image F.V.D.O.
2. Image of complete cinematic locking of object (C.C.L.O.)
3. Internal classificatory and direct causal connections between image F.V.D.O., image C.C.L.O. and contact points.

This is able to provide the activities of the tool of capture reliability prognosis of non-oriented complex shape objects for manipulating robots:

$$\hat{\text{O}}_{\text{íá}}^{\text{N}} - [\hat{\text{O}}] \Rightarrow \Delta\hat{\text{O}}_{\text{íá}}^{\text{N}} \Rightarrow \text{sign}\,\Delta\hat{\text{O}}_{\text{íá}} \begin{vmatrix} \oplus\Delta\hat{\text{O}} > 0 \\ \oplus\Delta\hat{\text{O}} = 0 \\ \Theta\,\Delta\hat{\text{O}} < 0 \end{vmatrix} \Rightarrow \text{ÏÐ}^{\text{Î}}.$$

$Φ_{об}^{N}$ – Factual image F.V.D.O,

N – Quantity of contact point connections,

[Φ] – Image F.V.D.O. with permissible parameters,

$ПР^{O}$ – Prognosis of capture reliability.

So it is important to create the image F.V.D.O. as a *constant unit* independent of any change of contact forces during object manipulation.

It is assumed that the solution of the problem is able to provide the c*omplete essence* of the problem and the whole procedure of its solving by representation of formalized interdisciplinary knowledge. It is able to apply three basic principles of Contextual Theory of Cognitive States such as:

- *Rationality* by representation of taking decision adequate to the actual problem,

- *Cognitive Relativity* by representation of the semantic structure of relations (non-dimension relative positions of contact points) connected with geometrical sectors of fixing virtual displacements of object. It is possible to recognize the real physical situation in system “H-O“ and apply the relations of contact points by way of the signs of capture reliability prognosis before object raising.

- *Clarity* by representation of the semantic information component with image presentation. Finding the semantic component of any activities should leave behind realization of these activities.

As the result it is possible to present ideas for solving problem and new methods for their realization taken from biology and transformed according to the laws of physics and other disciplines in useful information forms with decisions, which need to coordinate algorithms of functioning and designs of control system and mechanisms of created technical systems.

This is the technical simulation of the *wonderful possibility of natural (human) mind – foresight of the result of situation developments in indeterminate conditions* by evaluating the future events for solution of the problem.

Above mentioned put into the project of model of artificial intellectual hand with anthropomorphous fingers and palm of matrix type assigned for unstressed gripping of non-oriented complex shape objects.

3. Conclusion

As the result, solving of the mentioned problem in co-operation with achieved possibilities of modern manipulating robotics will allow development of future intellectual robotics and also new type of intellectual prosthesis for invalids (and even for withered hands) to perform new principle qualitative functional jump. In other words, to turn into unknown and inaccessible earlier area of human activities as direct executor of "hand-type" and "mechanized" works in indeterminate conditions. So it is possible to turn in human abode due to the new possibility to determine natural surrounding (analogy of human subconscious, forced and constant activities).

That can generate the wave of necessities as to replace the workingman by robotics in extreme and natural surroundings and so to develop these techniques. This is the reason to create the analogy due to the active role of human hand in material and spiritual fields of human activities as the steps on the way of evolution processes of humanity as itself and it's civilization.

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The Concept of Well-being in the Russian and Spanish Linguocultures: Associative Classification

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Abstract: *This article dwells upon the question of similarities and differences in the concept of well-being in the Russian and Spanish linguocultures. It presents the results of an associative experiment with the words* ***благосостояние*** *and* ***bienestar****. A comparative analysis of the associative structure of the concept of well-being in the Russian and Spanish languages is given.*

Keywords: concept; associative experiment; well-being

It is widely recognized that the mentality of human beings is reflected in the concept, which is a basic notion for cognitive linguistics and linguoculturology. Although concepts in different cultures do not coincide, it is possible to mark out a number of universal elements which are equally perceived in all the cultures and therefore make it possible to compare concepts in different cultures. A concept expressed in the language by an abstract noun is of special interest as it has no denotation in the non-linguistic reality and is representative of the national picture of the world.

The interest towards the concept of well-being has increased lately. In the contemporary world the well-being ranking is used to evaluate and compare countries and their economies. But if economists are quite unanimous in their understanding of well-being measuring, the concept of well-being is complicated and does not coincide in different cultures and even in the perception of different representatives of the same culture. This is a clear example of the principle of Cognitive Relativity according to which the same phenomenon can be observed from different perspectives. Actually, it should be observed from different positions in order to avoid possible misunderstandings. When a Russian and a Spanish politician talk about well-being, they actually mean different things: our research proves that *благосостояние* in the Russian linguoculture is not the same as *bienestar* for Spanish people.

There are different methods of studying concepts: building a lexical-semantic field of the key lexeme, synonyms and derivatives analysis, combinatory analysis of the key lexeme, discourse analysis, among others. Another method is a psycholinguistic experiment which reveals the associative field of a concept. One of the founders of experimental study of semantic phenomena was L. Scherba who put forward the idea of checking linguists' assumptions by experimenting with the context. As for associative experiments, already Aristotle mentioned that there were three types of connection among notions: by contiguity, by similarity and by contrast. Nevertheless, the first associative model was built not earlier than the 17-th century by R. Descartes, T. Hobbs and B. Spinoza while the term "association" was offered in 1690 by J. Locke.

Verbal associations became an object of study starting from the 19-th century. The investigations were held within two main trends: the traditional linguistic trend represented mainly by Russian linguists A. Potebnya, I. Boduen de Kurtene, N. Krushevsky and the experimental psychological trend whose leaders were G. Kent, J. Miller, Ch. Koffer and others. Different methods of holding associative experiments are described in the works of Russian scientists R. Frumkina, V. Belyanin, E. Goroshko, A. Zalevskaya, Yu. Karaulov.

A linguistic experiment carried out in two homogeneous groups of Russian and Spanish participants has exteriorized the associative structure of the concept of well-being in these cultures. About 500 reactions given by 100 participants to the words *благосостояние* and *bienestar* have been analyzed. The majority of associations were in the form of a word (83% for the Russian speakers and 96% for the Spanish speakers); this can be explained by the fact that the stimulus was also in the form of a single lexeme. The Russian participants have given more associations to the stimulus than the Spanish ones, and their reactions were more diverse. For both nationalities the answers by student respondents were two times more standard and repetitive than the answers given by university teachers who had a higher rate of original individual answers. The experiment has proved that the majority of reactions produced in a massive experiment are not unique: the diversity coefficient is 0,55 for Russian participants and 0,45 for Spanish participants. Many of them are associations by contiguity which reproduce the information already seen, heard or read earlier.

The associative structure of the concept of well-being in both Russian and Spanish linguocultures contains three segments: external characteristics of well-being, internal characteristics of well-being and physical characteristics of well-being. All the given reactions are distributed among these segments forming a communicative thematic field (CTF) consisting of thematic groups. The elements of the segments and the field on the whole are interconnected and the connections are of different types: for example, some of them are synonyms or antonyms, others have a hyponymy-hyperonymy type of connection.

The segment “external characteristics of well-being” in the Russian CTF contains 117 reactions, 59 of which are different. Among the most frequent reactions are the following: *деньги (18)* “money”, *достаток (9)* “prosperity”, *квартира (8)* “flat”, *дом (4)* “house, home”, *машина (4)* “car”, *работа (4)* “work, job”, *процветание (4)* “flourishing”, *богатство (4)* “richness”. The segment “external characteristics of well-being” in the Spanish CTF consists of 37 reactions, 24 of which are different. The most frequent are: *comodidad (11)* “comfort”, *dinero (3)* “money”, *sofá (2)* “sofa”.

In the segment “internal characteristics of well-being” in the Russian CTF there are also 117 reactions, 66 of them are different. The following reactions appeared more frequently: *счастье (10)* “happiness”*, успех (8)* “success”*, семья (8)* “family”*, друзья (3)* “friends”*, море (3)* “sea”*, радость (3)* “joy”*, свобода (3)* “freedom”*.* In the Spanish CTF there are 132 associations in this group, much more than in the previous one, with 57 different reactions. Especially frequent are *tranquilidad (16)* “tranquillity”*, felicidad (15)* “happiness*, amor (7)* “love”*, estabilidad (7)* “stability”*, alegría (5)* “joy”, *paz (4)* “peace” *, familia (8)* “family”*, amistad (7)* “friendship”*, pareja (3)* “couple, partner”*, relajación (3)* “relax”*.*

The segment “physical characteristics of well-being” in the Russian CTF has 19 reactions, of which 7 are different and the most frequent reaction is *здоровье (10)* “health”. In the Spanish CTF this segment contains 40 reactions, 14 of them are different. The reaction *salud* “health” was named by 26 participants.

The analysis of the associative structure of the concept of well-being in the Russian and Spanish cultures proves that for the Russians well being (благосостояние) is mainly a material concept associated to the presence of money and other material gadgets whereas for the Spanish well-being (bienestar) is more an emotional concept which is a synonym to a quiet happy life. Both the Russians and the Spanish do not contemplate well-being without health, the Spanish even to a greater extend.

The explanation for these differences can be partly found in the components of the compound words *благосостояние* and *bienestar*: a modern and a very popular meaning of the Russian word *состояние* is “property” and the expression *estar bien* in the Spanish language has the meaning “to be in a good health”. Of course, there are cultural differences involved as well, including the predominance of pleasure and rest upon working and money gaining, characteristic of Mediterranean cultures, including the Spanish one. The political system and the economic state of the country cannot be ignored either. Spain is a European country and the idea of building a welfare state is very familiar to its citizens; so well-being for the Spanish is related to a number of factors which influence the quality of people's lives. These ideas are not equally assimilated in the Russian culture, so the ideas the Russians have on well-being are vaguer.

After the associative experiment the participants had to answer a number of direct questions on their well-being perception. The Spanish respondents quite unanimously answered that well-being was closely linked to the feeling of happiness, then to health and only then to a good economic situation. Their evaluation of their own well-being varied between 5 and 10 points out of ten. The Russian speakers gave very disperse answers and they marked their own well-being from 1 to 10, showing either a huge difference in the real well-being of the respondents or the absence of an integral understanding of this concept by the Russian language speakers, which is more likely. Nevertheless, when participants had to describe well-being as a concrete object, the answers of the Russians and the Spanish were alike. They conceive it as something big, soft, round, yellow, sweet, warm, light and shining. Therefore, the sensory perception of well-being by the Russians the Spanish has no special differences: they perceive it as something highly positive and pleasant.

The results of the linguistic experiment prove the observations I had previously made upon introspective analysis of the concept of well-being adding some linguo-pragmatic strokes to the whole picture. The complexity of the concept of well-being leads to the vagueness of its interpretations by representatives of different cultures. The present research may be beneficial for a better communication and comprehension of the Russians and the Spanish when they want to come to an agreement on what well-being is.

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Symposium Q. How to Manage Human Organisations in a Crisis Context. Systemic Theoretical Knowledge Applied to Practical Action

Chairs: Guy Koninckx, S&O A.S.B.L, Groupe d'Intervention et de Recherche en organisation des Systèmes (G.I.R.O.S.), and UES, Brussels, Belgium, Claude Lambert, Prosoft Sàrl, Kleinbettingen, Luxembourg, S&O A.S.B.L., G.I.R.O.S., and UES, Brussels, Belgium, Rafael Lostado Bojó, University of Valencia, Spain, Presidente de la Sociedad Española de Sistemas Generales (SESGE), and President of UES, Alexandre Makarovitsch, Professeur associé à l'IMA/UCO, AFSCET, Emergence group, and UES, Paris, Andrée Piecq, G.I.R.O.S., S&O A.S.B.L., and General Secretary of UES, Brussels, Belgium, Valérie Renault, Research engineer at the University of Technology of Troyes, AFSCET, and UES, France, Maria Sanz, Universidad CEU Cardenal Herrera, SESGE, and UES, Spain, and Anne Steenhout, Groupe d'Etudes Ecotoxicologiques sur les Polluants, la Santé et les Impacts sur l'Homme (GEEPSIH), IGEAT (Institut pour la Gestion de l'Environnement et l'Aménagement du Territoire), Faculté des Sciences, Université Libre de Bruxelles, S&O A.S.B.L., and UES, Belgium

Complexity and diversity become the first challenge of our time. This symposium aims to present and discuss observations showing that the pressure applied to scientific and civil societies, makes them suffer and is leading to a peculiar societal context: a global crisis becoming more dangerous day by day because of the emergence of exclusion, discrimination, nationalism, violence, fanaticism, extinction of species, environment poisoning, run to maximum productivity, to speculation, and the pressure to always make something new in all fields. We can say that all those behaviours may be the symptoms of the beginning of the twenty-first century. All of us are pushed by a storm of changes. Homeostasis and the no-change can't exist. There is no time for understanding and thinking. Everything must be done as if in cases of urgency and when something is just finished it needs to be changed again and again in an endless circular chain. That allows us to say that things are as if everything must always be done in more quantity, ever faster, without pause, without limit, without feedback. Why?

We must enter a new era. If humanity wants to survive, grow and organize itself facing all stacking of societal problems, facing the emergence of new discoveries, our approach toward phenomena has to change. Time has brought us to a new way of seeing societal and environmental programs and the behaviours. The understanding of all these problems will emerge by the study of complexity, of transdisciplinarity. A holistic education may lead to a Meta level.

How?

"La difficulté n'est pas de comprendre les idées nouvelles mais d'échapper à l'emprise des idées anciennes."

"La dificultad no es comprender las ideas nuevas, es escapar de la influencia de las ideas antiguas."

"The difficulty is not to understand the new ideas but to escape the influence of the former ones."

"La difficoltà non è di comprendere le idee nuove, è di liberarsi delle idee vecchie."

"Die Schwierigkeit das besteht nicht darin die neuen Ideen zu verstehen, das besteht darin sich von alten Ideen zu befreien."

The aim of this symposium is to identify similarities, analogies, and differences in fields of research and practices. We want to put together persons who have different viewpoints, different experiences in the practice of organisations: pedagogues, doctors, economists… to show how action and research are indissociable.

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Andrée Piecq: *Systemic Theoretical Knowledge Applied to Practical Action - Strategies to Manage Human Organization in a Crisis Context*

Rafael Lostado: *SISPROMA: A Knowledge and Integration Platform for Systemics and Project Management to Train Professionals in Managing Change during Crises*

Alexandre Makarovitsch: *Boundaries, Brakes and/or Boosters*

Claude Lambert: *A Transdisciplinarian Look on Coordination and Co-operation in Organizations*

Maria T. Sanz, Joan C. Micó, Antonio Caselles & David Soler: *Welfare and Human Population in Austria*

Anne Steenhout: *An Ecosystemic Approach of Complexity in the Field of Environment and Health - Scientific Assessment, Addressing Vulnerabilities and the Potential for Action*

Valérie Renault: *A Systemic "Compass" to Manage a Housing Project's Complexity*

Guy Koninckx: *Organizational Resilience: A Crisis Response?*

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Systemic Theoretical Knowledge Applied to Practical Action

Strategies to Manage Human Organization in a Crisis Context

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Abstract: *All Organizations met crisis. How to manage organizations in this context? Our model gives a systemic answer to the analysis of the organization's structure with the Managing Principles of system and also with "The circular evaluation of the systems". To accede the Managing Principles we observe the interactions of behavior and also the interaction between Managing Principles. The Managing Principles developed strategies for change.*

Keywords*:* context; managing Principles; circular evaluation; structure; interaction

Acknowledgement: My thanks to the members of my team for the exchanges of views and their suggestions during the years when I try to put words about my research work. I thank particularly my fellow Guy Koninckx, and dr. Patrick Mesters and Mrs. Chantal Bastin for their help during so many years

To all organizations a crisis can arrive and we must manage it, and introduce changes to permit the organization to live. The question is how to introduce the necessary changes?

To understand how to deal with organization in a crisis context, our systemic model evidenced two organization's states: one "operative" and a second "non operative. "The organizations, during their life, shift from one state to the other.

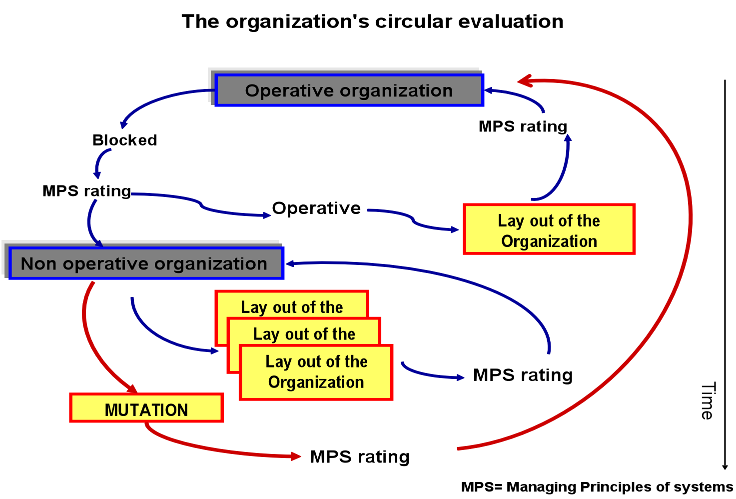

Figure 1

In a crisis situation the "operative organization" is able to pass the difficulties without touching its structure (the specific meaning of "structure" is explained later). For the "non operative organization" it is impossible to keep its structure as it is and the structure must be changed.

To be able to pilot this changing, it is necessary to make a diagnostic in view to avoid errors when managing the change. Or systemic circular model “The circular evaluation of the system: Managing Principles and strategically change of the systems”, allows such a diagnostic.

1. How to do?

1.1. Characterizing crisis context

We consider a crisis context the moment when a paroxysm of suffering, contradictions and uncertainties appear, which produce bursts of violence or rebellion. The crisis is an imbalance. During all its history the world met all sort of crisis: economic, societal, political, ecological…

1.2. How to establish a diagnostic of an organization

We apply our model “The 12 Managing Principles of System”.

The observation of the organizations leads to identify patterns, which are all subject to “ the 12 Managing Principles of systems”. The concepts grouped under the term “Managing Principles” have been studied by the authors of The Systems Theory as Ludwig von Bertalanffy, Heinz von Forester, Gregory Bateson, Fransisco Varela, Humberto Maturana, Ilya Prigogine, Paul Watslawick, Edgard Morin, Joël de Rosnay ; this list is not exhaustive.

The structure of an organisation can be considered as a set of interacting elements forming a cohesive and complex unit. This set of elements form “the Managing Principles of systems”, which interact each other.

The organization’s structure can be compared by analogy to a structure that support the walls of a building and provide its stability.

The model is circular and takes into account the complexity. It mustbe kept in mind that this is a model and that “the map is not the territory” as stated by Alfred Korzybski.

The originality of the “Managing Principles” is to provide access to the study of the structure of the organization to make a diagnosis, to be able to develop strategies for change.

To access to the structure of the organization, “the managing principles”, observe the interactions of behaviour (verbal or nonverbal) between its members, between the sub-systems (sub-organization), between the “Managing Principles” themselves.

The organisation’s context is a logical level higher than the “Managing Principles”. It must be considered as a “meta managing principle”. It gives meaning to those principles, as if it gives their colors.

Indeed, any kind of organization is totally dependent of their context (temporal, relational,…) in this case the context is “The crisis”.

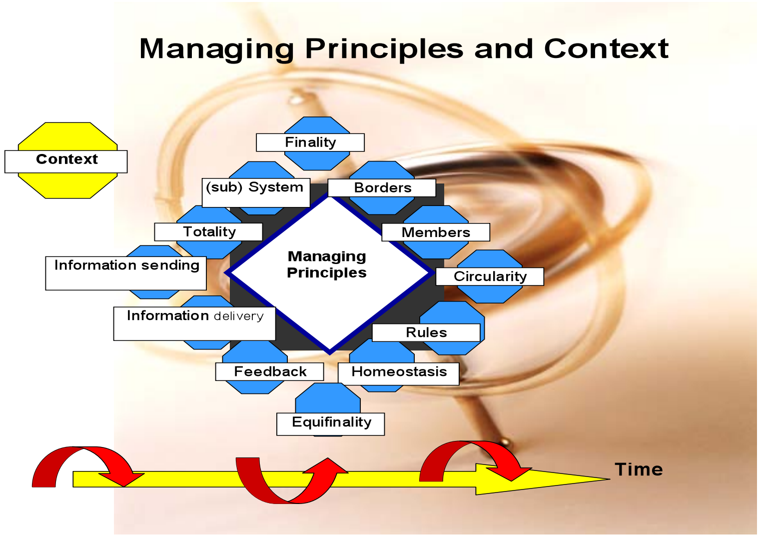

Figure 2

1.3. Strategies to manage an organization in a crisis context

Our model of the change concerns the organization's functioning. It is not an individual change.

As I. Prigogine said, to permit the apparition of a systemically change, a deviation from a point of balance is necessary. This deviation is a local and temporary fluctuation from inside or outside the organization.

The observation of the organizations with the 12 Managing Principles permit us to say, that it is, as if all organizations are "non operative". To introduce change it is necessary to use a mutation: ie to introduce a changing structure. The interactions between the behaviors, between the principles themselves, lead to this changing.

In the actual crisis, moving, leak, perpetual change conduct the organization far from the balance. All are pushed in a storm of changes. Homeostasis and no-change can't exist. There in no time for understanding and though. Hence the mutation is as a paradox: to change we must introduce no-change and homeostasis!

Then we permit the change with taking time for understanding and thinking.

2. Conclusion

All organizations interact with their contexts. In this paper we look at the organization in a crisis context. To do this we used the Managing Principles applied to human organizations. But these Managing Principles can be applied to any systems. They can find answers to question such as how systems are able to evolve. How to describe and manage them? How stimulate the relationship between systemic properties and their interactions?

Currently the Systemic thought is risking to loose a lot of its qualities, because too often it is reduced to a methodology of actions and looses it power of acquiring knowledge.

Our methodology aims to understand the two aspects: the theory and the practice.

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SISPROMA: A Knowledge and Integration Platform for Systemics and Project Management to Train Professionals in Managing Change during Crises

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Abstract: *We present the SISPROMA platform in order to meet Spain's demand for the professionals needed to manage organisations in chaotic situations. In order to do so, we have used a knowledge management platform based on e-learning that integrates the best practices in Project Management and which is available in three professional training packages that have been launched by the Research Institute on Social Welfare Policy at the University of Valencia (Spain) in cooperation with public and private institutions.*

Keywords: PMBOK; NCB; PRINCE2; Project Management Institute; International Project Management Association; SESGE; Research Institute on Social Welfare Policy; systemic project; systemic project manager

1. Introduction

This document presents the SISPROMA platform, which is intended to meet the professional training needs of Spain in general and intermediate-level executives in particular in any type of socioeconomic organisation in order to respond to the demands of the current crisis or any other situation of change.

SISPROMA approaches the need for feedback in a systemic view of organisations using Project Management to implement any measure at any existing levels of organisation.

2. Crisis, Systemics and Project Management

A crisis is nothing more and nothing less than the acknowledgement of a chaotic situation in which uncertainty increases and the pre-established order has been disrupted (imbalance), affecting different variables: (GDP) growth, public debt, budget deficit, unemployment, balance of payments, etc... The measures intended to counter a crisis normally "attack" each of these variables using different structures (Ministries) in order to recover their pre-crisis levels. In some cases, they use contradictory economic policies and in most cases deterministic policies, without there being a minimum assessment of the results or discussion of the lessons that have been learned.

For experts in **systemics**, it is relatively easy to diagnose crisis situations: a lack of systemic vision in socioeconomic policy will result in the necessary utilisation of a great deal of unproductive effort to return to the pre-crisis situation. Consequently, we propose a systemic model, either to analyse aspects of the situation (Caselles et al., 2011), to contribute specific solutions (Parra Luna, 2010) or to at least spark a serious debate on the subject.

In the case of **Project Managers**, there is no diagnosis of a situation that we intend to change, simply the mandate of a "sponsor" of the project that provides the necessary resources, imposes a given scope and sets the goals to be achieved in the project so that the project manager can achieve them within the deadline, budget and to the satisfaction of the sponsor who becomes the project client.

3. Missing Link between Systemics and Project Management

The models proposed by experts in Systemics for high levels of management in organisations are implemented on very few occasions. And, even if they are implemented, the very working structure that exists rapidly cancels any systemic vision. Parallel to this, a systemic view is also absent from the design and implementation of the majority of projects, which are applied overly deterministically. If this occurs both at the highest level of decision making (Systemics) and also at lower levels of transforming the reality (Project Management), we can also expect it to occur little by little at intermediate levels of management in organisations.

In this sense, two considerations must be made: a) **Systemics** has remained practically stagnant since the 1960s and the message it transmits has still not reached society; b) In contrast, modern **Project Management**, which took shape in the 1960s enjoys extraordinary international popularity. There are more than 1,000,000 certified Project Managers in the world and the number is growing at a rate of more than 20% a year. Their principles are progressively being adopted by the Public Sector as a whole, as well as private organisations. We must use this strength to help the message of systemics reach society.

4. Our Proposal: Creation of a Knowledge and Integration Platform for Systemics and Project Management (SISPROMA)

The Spanish Society of General Systems (SESGE), the Research Institute on Social Welfare Policy at the University of Valencia and other Research Teams have cooperated in the development of SISPROMA, which boasts the knowledge and experience of tens of professionals and years of work devoted to Systemics and Project Management. We intend to meet the demand for professionals who wish be more productive and generate creative and adaptable solutions.

In order to do so, the SISPROMA system is made up of three projects, one for each stage of development:

Stage I: Design an initial professional training product that:

- Educates Project Managers in this subject;
- Provides them with international certification;
- Teaches students to manage a project in accordance with international standards;
- Arouses students' interest in systemics.

This product is called the Master's in Project Management and Administration run by the University of Valencia. There have been 10 editions of the Master's to date and some 400 students have completed the course.

Stage II: Design a second professional training product that:

- Educates Programme Managers in this subject;
- Provides them with international certification;
- Teaches students to manage an organisations using projects and according to international standards;
- Approaches the management of an organisation through projects from a systemics perspective.

This product is called the Master's in Performance Management run by the University of Valencia. There has been 1 edition and there are 2 students.

Stage III: Design a professional training product that:

- Provides basic training in systemics for anyone;
- Arouses student interest in Systemic Project Management.

This product is called the Master's in Complexity Management and Systems Science run by the University of Valencia. This product is currently in the process of assessment and approval on behalf of the University of Valencia.

The platform is intended to:

- Create a critical mass of Systemic Project experts or Project Managers to be the basic supply demanded by Spanish society;
- Have a permanent forum where learning synergies can be created and applied to real situations;
- Rejuvenate, foster and guarantee the future of the SESGE.

5. Conclusion

The most important contribution that systemics can make to society in a situation of crisis is to come out of its coma. Systemics needs to reinvent itself to reach different groups of people, particularly Project Managers, who are transforming the world deterministically. SISPROMA aims to achieve this goal.

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Boundaries, Brakes and/or Boosters

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Abstract: *Boundaries are a multi-dimensional space fact and concept. Their existence, perception and usage might be viewed through different lenses. Boundaries are a fundamental and mandatory component of Systems. We have chosen to discuss boundaries as brakes, impeachers, obstacles for thinking and action, as well as the contrary: boosters, facilitators, inciters, for thinking and action. Boundaries are taken in account from long time ago under their classical, notably geographical form. The new century we are entering, brings new dimensions to the boundaries through the development of technology and the societal changes which follow. These new kinds of boundaries, like those present in networks, as their classical counterparts, might be brakes and/or boosters. In human groups and organizations the actual considering and taking in account, and even construction of boundaries is necessary for a better dynamics and management of the above.*

Keywords: boundaries; geography; systems; complexity; networks; organizations; management

1. Introduction

This presentation is the result of an on-going research on the systemic aspect of boundaries. We will briefly examine only a couple of aspects of the boundary concept: their function as brakes and/or boosters.

Usually, and our experience confirms it, people individually or in groups and organizations, do not explicitly consider boundaries as such, either in their normal activity or in their related thinking. These are usually limited to their physical or geographical meaning, which even if very important, is not the only ones to be considered.

Our view is that boundaries are at the same time, tools for models building, fundamental mechanisms of systems which should be carefully taken in account, and also physical entities having their importance as such. Boundaries are everywhere, within us and in our surroundings.

The subject of boundaries is more than vast; thousands of pages written over 2000 years cover this subject. Our contribution remains indeed, very modest. Our hope is that it will present an aspect, which is often overlooked.

2. The boundary as a concept and physical reality

A number of different words cover this slippery and everywhere present concept: boundary, border, frontier, and limit. It is an unavoidable concept, which concerns all actors and their interactions, which are as such, frontier crossings. Any complex system has internal and external boundaries. Traditionally, boundaries are ways to separate geographical regions for different reasons. It is interesting to note that the activity of boundary building continues currently at a quite fast pace.

In Systems theory boundaries have a mandatory existence. They might be stable or unstable (time and dynamics dependent), sharp or fuzzy, visible or invisible. Emergence, one of the still open problems in systems is in fact a consequence of the separation in levels.

The fast technology development has brought new aspects of boundaries into the limelight. Networks and notably social networks have their own boundaries, which impose new constraints as well as enlarge the horizons. Not to be forgotten, are also the social boundaries within and between human societies and groups, and the management boundaries related to organizations.

3. The boundary as a brake

For sure, boundaries are considered first as a barrier, as a limit not to be crossed. Examples are numerous, not only in geography. Psychological boundaries are plethora. But, interestingly enough, the human being has a propensity to get over these, very often with dramatic consequences. On the other hand their very existence refrains from transgressing them without some kind of authorization, or knowledge, or even courage. Also, boundaries allow for some kind of insulation (by defining and maintaining an "inside" and an "outside"), which actually makes life possible. Filtering is also one of the functions, which might be assimilated with a kind of brake. Standards, rituals, might also be viewed as brakes.

4. The boundary as a booster

As unexpected as it might be, boundaries are also boosters in the sense that humans strive to push these as far away as possible, to free their moves. Their very existence becomes an injunction to get over.

An objective might be considered as a booster, but is in fact a boundary. It focuses the action, and is at the same time implies the necessity to get over a set of borders, frontiers encountered on the way towards attaining the said objective. The process of managing an organization is at the same time building a collection boundaries, and stepping over other existing ones which prevent the move forward. Standards might be viewed also as boosters, creating openness, for further innovative approaches.

5. The new boundaries

The concept of boundary being so ubiquitous, as life goes, centuries accumulate, technologies evolve, new kinds of boundaries appear, and are part of the complexity our society experiences.

Probably the most notably type of boundary is that we encounter in networks. Networks become one of the major presences of our times. There are a number of boundaries, which could be discerned within a network: its physical limits, its transmission speed, its reliability, the range by interaction type, and more.

Some authors have even found a new name to these types of boundaries: reticular boundaries.

Are these brakes or boosters? They are both. And one has to understand that these boundaries are not stable in time, they are not directly visible – and therefore more difficult to deal with. They might also be fuzzy. In general, the new systems, which cover the world at electronic speed, like the financial systems or the social networks, create, on one hand an incredible openness, and on the other hand might be a brake to the society development.

Their processing gets these days more and more important, but is still a craftsmanship, an artwork.

6. Conclusion

Our view for now is that indeed, there is no way for a properly conceived management, to ignore the boundary as a concept, to use it in the daily quest for attaining objectives in the best mode. The boundary has a presence of every moment in our lives as persons or group or organization members and therefore treating it as a secondary item or neglecting it, will necessarily lead to failure.

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Born in 1937. French citizen.

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A Transdisciplinarian Look on Coordination and Co-operation in Organizations

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Abstract: *The management of the organizations includes coordination and co-operation. These two concepts have antagonisms: freedom and obligation, measurement and not-measurement, …. Based on anthropological and sociological studies of Bronislav Malinowski and Marcel Mauss we can distinguish two networks from separate exchanges. A network functions on the basis of circuit of the commercial type the other based on the ceremonial gift. This distinction makes it possible to highlight an overlap of loops functioning on apparently irreconcilable different criteria. While basing itself on the antagonistic logic of Stephan Lupasco and the concept of level of reality brought by Basarab Nicolescu, we connect two levels of realities reconciled by the concept of Third-included. By supporting us on trialectic modeling, we can connect a set of concepts to work in the registers of the action, management and the attitude.*

Keywords: coordination; co-operation; antagonism; third-included

Acknowledgement: Specials thanks to Andrée Piecq and Gerard Gigand for their support along this research work. I also thank Dominique De Kuyssche who made me discover the systemic approach, Dominique Bériot for sharing his experiment as systemic consultant in organizations.

The current crisis affects the human organizations whose marketing companies, the continuation of this communication is a focusing on this kind of organization which saw apparently contradictory needs.

The modern company needs to reach its finality for coordination and the co-operation of the members. Coordination raises of procedures, standards, formal regulations based on circuits of information, mechanisms of feedback. The practice shows that the commitment necessary to the co-operation is of another kind that coordination i.e. contract, function or wage counterpart.

In a preceding communication, I had highlighted a homomorphism between the ceremonial gift practised in the antiquated society and the non-official network, like sits of the co-operation within the organizations. Anthropology and sociology provide us interesting descriptions in particular thanks to work of B.Malinwoski, M.Mauss which is largely resumed by the French School of Sociology.

A significant observation is provided by the description of the networks of exchanges in the Trobriand Islands. People of Trobriand Islands have two circuits of clearly distinct exchanges: Kuhla and Gimwali. Kuhla is a circuit of symbolic exchanges whose finality is coalition; the exchanged objects do not require an immediate counterpart, nor a negotiation on equivalence of value. The received gift obliges the donee with respect to the giver. In this network, the whole of the protagonists are related to others by these gifts in a positive mutual debt. Gimwali, on the other hand, is a network of exchanges of the utility types in which, there is negotiation on the equivalence of the goods and cancellation of the debt in the exchange. It is the commercial exchange.

These anthropological and sociological observations teach us that the rules governing the two circuits are different in many connections: measure and not-quantified, debt and equivalence, spontaneousness and contract, freedom and obligation.

I had then clarified that there is a possible analogy between what is described in these archaic society and what is observed in company in terms of networks of exchanges in which a formal organization and an non-official organization coexist.

By analogy, one can make the assumption that the abstract organization functions with rules similar to that of the ceremonial exchange (Kuhla). Concretely in the modern organization, this network allows the exchange of the knowledge and know-how. It is a space where sets up initiatives, even the innovation.

The company integrates that very little this dimension or then in an awkward way. Indeed, the look on the phenomena of gift is too often based on the concepts issued from contractual exchange at best. It is the case in the attempts to make a contract of the donation, its outsourcing or its implicit refusal by the company. Moreover, the acceleration of the events, the pressures coming from the general context make that the donation in company is in a difficult situation by the ceaseless changes such as the phenomena of mobility which prevents the installation of durable bonds, by the rationalization of time, spaces and the resources, by the invisible generation of work,…

If this analogy is relevant, we can be guided by the systemic analysis through the relations between guiding principles such as circularity, totality, finality, members, etc…. These observations enable us to take care of the non-official circuits, which take part of the operation of the system and to integrate them in the diagnosis.

It remains however that the concepts with work such as freedom and the obligation, the interest and satisfying, short-term and long-term, celebration and rationalization leaves us seemingly in a strange situation of irreconcilable concepts. Discomfort can discourage and even consolidate the observer to make the dead end on these factors, which give the giddiness considering their contradictory character.

A different lighting can be to us brought in particular by the antagonistic logic of Stephan Lupasco and the contribution of Basarab Nicolescu on the concept of level of reality and level of perception.

Stephan Lupasco, a French philosopher, drew from the scientific work of the beginning of the 20th century to work out antagonistic logic. It is based on the quantum physics which reveals antagonisms with the observers which we are, located in the macroscopic world: whose antagonism celebrates between wave and corpuscle. Lupasco based himself in particular on the principle of exclusion of Wolfgang Pauli postulating that two particles, such as the electron, cannot be in the same quantum state at a given time. This principle is carrying heterogeneization, differentiation, individualization. In addition, Lupasco inspires its reflection on the second principle of the thermodynamics (Principle of Carnot) which says that any system is directed towards an increasing homogeneity: entropy. These two principles coexist in an energy system without cancelling itself. This antagonism is expressed in a relation in which the potentialization of the one of the terms involves the actualization of the other. In other words, where the homogenization increases (is brought up to date) the heterogeneization decrease (potentiates itself), and vice versa. Some systems are directed towards an increasing homogenization (inert matter), others towards an increasing heterogeneization (living matter). Lastly, Lupasco introduces the concept of third-included like term including the antagonistic system. Third-included comes to upset the Aristotelian logic whose three axioms are the following: axiom of identity: A is A, axiom of non-contradiction: A is not non-A, axiom of third-excluded: There does not exist term T which are at the same time A and non-A.

The axiomatic of Lupasco, redefined the logic in this manner: axiom of identity: A is A, axiom of non-contradiction: A is not non-A, axiom of third-not included: There exists a third term T which include A and non-A

Based on this work, Basarab Nicolescu, introduced the concept of level of reality which postulates that third-included it is located at a level of reality higher than the restoring torque. It distinguishes two levels from realities by a rupture (discontinuity) of the concepts and laws between the two levels. In physics, this rupture exists between the world microphysics and the physical macro world.

He adds that for each level of reality corresponds a different level of perception. Indeed, we do not use the same instruments of observation for the microscopic and macroscopic events.

This concept of level of reality should not be confused with that of level of organization.

To focus back on the topic of this communication, I make the assumption that the ceremonial exchange and the commercial exchange are not located on the same level of reality. This assumption joined the assertion of Marcel Mauss describing the ceremonial gift like “total social Phenomenon”, including the other forms of exchanges.

By analogy, coordination and the co-operation would thus concern two different levels of reality.

This glance gives existing direction to antagonisms. For example, freedom and obligation are two concepts which are opposed to a level but are reconciled at the level higher thanks to third-included coalition. Coalition is neither freedom, nor obligation but it is also freedom and obligation. The illusion of an absolute actualization of one term compared to the other on exclude the third-included. That is quite as relevant if one excessively brings up to date the constraints and the obligations by denying freedom that if one deceives oneself in an unconstrained absolute freedom. One like the other approach kills third-included it and cuts down the field by the possible ones. We could thus continue with the other antagonistic concepts with work, which this communication does not allow.

It should be noted that third-included does not raise of the compromise which concerns the reduction on only one level of reality.

Just like the world microphysics exists within the world macrophysic, the co-operation and coordination coexists. In general that which is in the world macrophysic has only to very seldom take account of the concepts with work in the world. On the other hand, in the case of the company, the manager must be able to listen, observe and act on the two levels of reality. To be present at these two levels of reality also means to develop two different levels of perceptions and to have differentiated measuring instruments and actions.

This glance invites us to more understanding and avoids us errors such as temptation to solve by a contract the gift, to outsource it, quantify it, institute it… what by analogy would amount wanting to apply the concepts of traditional physics to the world microphysics.

The systemic principles are always of application to the various levels of realities. The principles of homeostasis, finality, of border, member, totality, circularity… are always essential for us to describe and analyze the system and its subsystems. What we have fact is simply there to associate the antagonistic logic of Lupasco (third-included, antagonistic system, potentialization, actualization), as well as the concepts of levels of realities and levels of perception.

Practically, according to the situations, that teaches us on the managing practices: the incomprehension between the hierarchical levels, the suspicion which exists on the intentions of the ones and others. For example, it is common that in a preoccupation with an improvement of the co-operation, the strategy used concerns measurements suitable for coordination and vice versa. The disenchantment thus generated often comes to reinforce the dysfunction.

These observations which we can make on the level of the marketing company can be wide with broader organizations (main road, regional or international).

In order to measure the width of this whole of assumptions based on the contributions of disciplines also varied, a work with trialectic modelling bringing into play the central themes approached will make it possible with rigor, to release the concepts grounds with work in the registers of the action, management and the attitude.

In conclusion, in this approach we have a conceptual and practical base to approach the complex relations between antagonistic topics. Indeed we have a logic, which gives volume to reality by the fitting of the levels of reality as well as a logic of passage between these levels, although discontinuous. And especially, we integrate antagonism like component of our lived reality and have tools allowing us to approach it with rigor.

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Claude Lambert

I am Belgian, was born in 1966. In 1987, I finish a graduate as systems analyst section economy. After few professional years as an employee, I created in 1992 a data-processing company (Prosoft Sàrl) whose activity is the development of management software bound for SME. I am still the manager today. Between 1997 and 2009, besides my occupation, I engage as voluntary in an organization of which part of the activities proceeds in Africa. During these ten years, I Co-organized the installation of structures supporting of the projects in humane matter in the training area, health, the Community activities. In 2007, as well my occupation as my voluntary commitment in Africa leads me to start again a formation. In 2009, I obtain a certification as coach in Gd.Duchy of Luxembourg. It is during this formation that I discover the systemic approach. In 2010, I engage in a certifying formation of systemic consultant in organization with team GIROS in Belgium. It is also in 2010, which I take contact with Gerard Gigand, we collaborate since in the development of the "Complexitude Workshop".

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Welfare and Human Population in Austria

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Abstract: *A stochastic model for a general human population dynamics is presented. Its main variables are population per sexes and welfare variables. These variables are considered in the UN welfare variables: Human Development Index, Gender Development Index and Gender Empowerment Index. The model has been validated for the case of Austria in the period 1999-2009.*

Keywords: deterministic model; stochastic model; human population; welfare variables; HDI; GDI; GEM; UN variables

1. Introduction

In this paper we present a stochastic mathematical model studying the evolution of human population per sexes, in which we have introduced three welfare variables. This model has been constructed because, the literature review shows that there is little research on the dynamics of human population considering both sexes, covering demographic processes such as births, deaths, migration, and depending on welfare variables.

There are some papers in which this kind of models is studied. One of them is the deterministic model presented by Sanz et al. (2011). In this case the model was validated for Belgium in the 1997-2008 period. On the other hand, Sanz et al. (in press) present a stochastic human population-dynamics model distinguishing genders and where fertility and mortality rates depend on *GDI*. The model is validated for Spain in the 2000-2006 period and applied to test different strategies in different scenarios to select government inversions for the 2006-2015 period.

Here, we use the same welfare variables that in Sanz et al. (2011), that is, *HDI*, *GDI* and *GEM* which are being used by UN to determine the quality of life of a country.

The main property of this model is that is abstract, i.e., it is transferable to any country. And this model is a tool for the study of human populations and their wellbeing. We emphasize the fact that this article presents a stochastic dynamic model in which the estimations in each period are obtained by means of a confidence interval given by a maximum value and a minimum value, which contains the corresponding real value with a specific probability. This way to present results provides a measure of its reliability, unlike deterministic models (Caselles, 1992).

2. The model

The model reflects the influence of fertility, mortality, emigration, immigration on the male and female population, as well as the relation between fertility and mortality rates with welfare variables (*HDI, GEM, GDI*). These rates are calculated from input variables and the resulting population.

2.1. Forrester's Diagram

The relations between all variables of the model are showed in Figure 1.

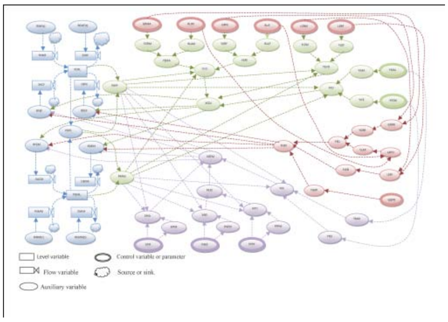

Figure 1: Forrester's Diagram (1961)

The equations of the model are the same that Sanz et al. (2011) presented. We note that the rates are written the different form in the stochastic model but this was all achieved by following the method proposed by Caselles (1992).

3. Validation

In this section the deterministic and stochastic validation are presented. We want emphasize that in the case of deterministic validation we only presented the graphics, because mathematical explanation can be seen in Sanz et al. (2011).

3.1. Deterministic Validation

The deterministic validation may be considered successful since all R^2 are over 0.9 and the relative errors do not exceed 5%.

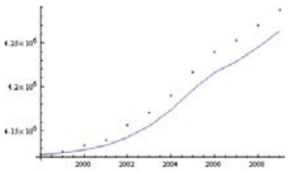

Figure 2: Forecast function (solid line) given by the model and real data (dots) for Austria's Male Population, in the period 1998-2009, R^2= 0.935006, with 0.586985% of maximum relative error. The model is considered validated, since the error does not exceed 5%.

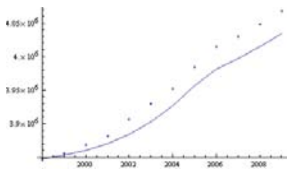

Figure 3: Forecast function (solid line) given by the model and real data (dots) for Austria's Female Population, in the period 1998-2009, R^2=0.920724, with 0.836716% of maximum relative error. The model is considered validated, since the error does not exceed 5%.

3.2. Stochastic Validation

The procedure to verify that the stochastic formulation of the model is validated is the following:

- Observing that all the results have a normal distribution (for this purpose, *SIGEM* automatically programs a χ^2 test).

- Creating a (for instance) 95% confidence interval for each result and checking that all the historical data are within this interval.

The results corresponding to this validation type are presented in Figures 4 and 5. They confirm that the model is valid for Austria in the 1999-2009 period.

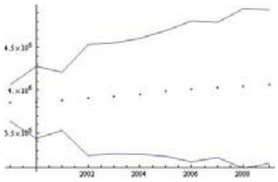

Figure 4: Male Austria Population 1999-2009. Maximum and minimum values (solid lines) and real values (dots).

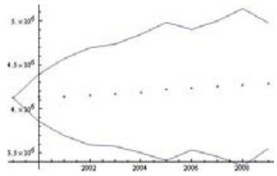

Figure 5: Female Austria Population 1999-2009. Maximum and minimum values (solid lines) and real values (dots).

4. Conclusion

An abstract model has been presented to study the dynamics of a human population per genders. Three welfare variables have been included in it. These variables are submitted by the United Nations, *HDI*, *GDI* and *GEM*.

The study was performed with two model formulations: deterministic formulation and stochastic. The deterministic formulation was validated with the functions obtained for the rates. On the other hand, the stochastic formulation introduces uncertainty in addition and calculates the reliability of results. Both formulations of the model have been validated with the corresponding criteria.

In the next works the stochastic model will be used to simulate the future because it allows us to determine the reliability of the results. And it can help to any country on their wellbeing, or on their demographic problems.

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An Ecosystemic Approach of Complexity in the Field of Environment and Health

Scientific Assessment, Addressing Vulnerabilities and the Potential for Action

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Abstract: *The contamination of ecosystems and of the living environment by toxic agents is a type of crisis issued by our technological society. There have been "early warnings" but they were often ignored or not fully taken into account to the extent they should have been to prevent worst impacts. We present here an ecosystemic approach in Environment and Health research that addresses a series of issues in combination. This approach is able to disentangle several levels of complexity while, meantime, it offers a systemic way to apply scientific knowledge into practical action.*

Keywords: environment and health; ecosystemic approach; children and sensitive groups; risk assessment of chemical substances

Toxic agents are emitted as a result of number of anthopogenic activities. Consumers are exposed through various routes of absorption, to a variety of sources of a contaminant, indoors/outdoors and to numerous substances. Exposure does not occur separately to single contaminants. There are potential synergetic effects, too. There is a need to understand the respective impacts from each factor and to build an approach addressing the effects of "mixtures" of multiple agents, the way they are encountered in the daily life.

We will present here our ecosystemic approach in Environment and Health and scopes of work that highlight how it is applicable to practical action. This research is of the "finalized" type. It combines fundamental research with services to the community; aimed at a better protection of ecosystems and of human beings.

Among the features of our approach, it bridged both fields since its very start, contrary to classic academic research in which bodies of knowledge were partitioned. This feature revealed to be rather powerful on the way to the goals.

It addresses all sources of exposure and various exposure routes. A special attention is paid to social vulnerabilities as well. Studies of the exposure to pollutant(s) according to socio-economic status (SES) showed that higher level of exposure to several contaminants can occur in lower SES groups in combination with other determinants of health, nutrition, housing and well-being in general. A series of "physiological" vulnerabilities could be identified in the developing child and accounted for. Additional tool performs validation exercises. It is able to distinguish and to quantify the respective contributions to lead body burden that result from external degree of exposure vs. these from internal transfers of the pollutant over time and age. The approach developed into a generic approach for metals and the issue of concomitant exposure to "cocktails" of contaminants such as metals and organic compounds is being addressed.

These features are needed in the field of environment and health risks. Indeed, European policy and Action Plans have now recognized that integrated strategies are necessary to handle environment and health issues. However, institutional opening to inter- , and trans- disciplinary approaches remains recent. Since decades, classical monitoring strategies and epidemiological surveys had worked with single-contaminant approaches and with one source and one route of exposure at a time. Bodies of knowledge were partitioned in academic research and policy-making was managed separately.

On the contrary, to address complex situations, we disentangle various layers of complexity that are still black-boxed in current approaches. This can be effort- and time- saving.

"How clean is really clean"? The relative efficiency of a degree of protection can be estimated within the ecosystemic approach, based on a number of factors together. The approach questions whether regulated "normal" limits of certain parameters do provide the level of protection of the population and of the environment to the extent that is expected from or do not and how much these numbers should be reduced further, in situations where the need for additional safety measures is identified.

In the field of chemical risks evaluations, our framework answers to the issue of the availability of good human data, by introducing strengthened criteria for evaluating and using epidemiological data. With reference a type of crisis created by our technological society and management, the approach opens a way toward more environmental equity and better governance.

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A Systemic "Compass" to Manage a Housing Project's Complexity

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Abstract: *The modern world is facing a global crisis that encompasses socio-economic problems as well as environmental degradations. This crisis has important impacts on the French housing sector. Using a systemic representation of sustainability that breaks with the economic myths of modern development, this work aims at elaborating a new tool for managing the crisis, in the housing sector specifically. The "systemic compass for sustainability evaluation" is then proposed as a management tool as well as an assessment grid and is applied to two housing projects.*

Keywords: paradigm; local government; citizen participation; public housing; constructivism (sociology); sustainable development; system analysis

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Modern development is mainly supported by a particular economic model, which has evolved since the nineteenth century. This economical system is itself the expression of a specific worldview and, in particular, some beliefs that have influenced our cultures and our way of seeing the world. The economy is, indeed, a reflection of how societies, families and individuals manage their resources, their "house" (oïkos), influenced by their own values. Existence and part of cultural practices as gift exchanges, equity in the resources distribution, limits to resources consumption, etc. are manifestations of a society's values through its economy.

Grand and al. *(2003)* state that the modern economy is based on three major beliefs. The belief in the market efficiency, developed by Friedman (1912-2006), the belief in an inexorable social evolution toward the maximized well-being of the largest number, advocated by Hayek (1899-1992), and the belief in the supremacy of material goods over spiritual goods,–introduced by Bentham's utilitarianism (1748-1832).

The economic model of modern development is now largely reduced to these three myths, leading to a perception of a human being mostly motivated by material and individual considerations. The development's ultimate goal is then to maximize the individual's material wealth.

The development of new technologies in physics, biology, genetics, and chemical and nuclear fields have supported, encouraged and reinforced the possibilities of achieving this finality with the industrialization of goods' production and means to secure them.

Therefore, happiness and wellbeing are considered in a quantitative way, which explains the international success of the Gross Domestic Product (GDP) as the ultimate indicator of a good economy, and thus, a good development.

Several consequences of these three myths can be observed on the ecosystem as well as on the social system.

On the ecosystem, the natural resources needed for this eternal growth of the couple production-consumption are showing their quantitative limits. Already in 1962, the Meadows's report (Meadows, 1979) explained, with a systemic approach applied to the earth system, that this economic model was not sustainable in the long term. At that time, this report was only a prediction but it is today demonstrated that biodiversity is indeed dramatically decreasing.

On a qualitative level, new technologies, chemicals in particular, and the enormous amounts of wastes have polluted all the ecosystem compartments: air, water, soils and food chain. As a boomerang effect, the environmental pollutions lead to huge public sanitary problems such as respiratory diseases, cancers, food contamination, water pollution, etc.

As a result, the negative environmental consequences of this economic model are now spoiling the growth's myths. The rise of social inequalities and unemployment, the economic crisis and the financial scandals are revealing the faults of this system.

These two kinds of troubles, social and environmental, are revealing the tremendous difficulty in managing a global system where responsibilities have become much diluted, and environmental and sanitary risks are increasingly harder to quantify, predict and manage.

To resolve these new systemic problems, two different kinds of solutions are proposed. They however claim the same concept of sustainable development.

In the housing field, the study of the major "sustainable" solutions shows that they do not deeply challenge the myths of modern development. Instead, they reinforce two important components of modernity: the predominance of expert systems and spatiotemporal distance between actions and their impacts (Giddens, 1994*)*. Consumers, then, must trust the opaque indicators like logos, labeling, normalization, marketing etc. that decreases further their sense of responsibility and the ability to manage their own environmental and social impacts.

The present work tries to build up an assessing method for sustainability as a tool to manage the change toward the new paradigm of sustainability. Starting with a systemic representation of the concept of sustainability *(Renault, 2010)*, we combined the "12 guiding principles of systems"© from the Group of Intervention and Research in Organization of Systems (GIROS) and the systemic approach of human communications (Mucchielli, 2006; 2007).

This resulted in the definition of three criteria regarding the elaboration of sustainability indicators: the paradigm underlying the assessment (systemic versus positivist), their purpose (local management versus global management), and the indicators visibility (direct visibility versus via expert systems).

The implementation of this method to the French housing sector enables to identify three major stakes for housing sustainability: the discrepancy of purposes between actors, the lack of visibility concerning flows and their impacts, and the focus on some aspects only of sustainability. Based on this observation, a "systemic compass for sustainability" (Figure 1) has been designed. The originality of this tool is to take into account the actors 'representation of sustainability issues, inciting them to build a common and systemic representation of the project.

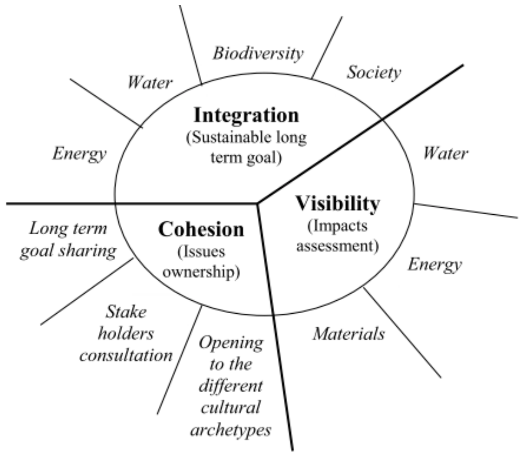

Figure 1: "Systemic compass for sustainability".

The “integration” pillar corresponds to the long term goal of the project which must integrate the environmental (energy, water and biodiversity) and societal dimensions of sustainability. The “visibility” pillar concerns the capacity for stakeholders to manage their own impacts which is made easier by local life cycle for materials as well as energy and water production – consumption cycle. The “cohesion” pillar is about the management tools the group can use to reinforce the precedent issues of ownership capacity: consultation, choose of engaged partners, opening to different cultural archetypes in the sense of Mary Douglas (Calvez, 2006). The tool can be used as a support to build, in a participatory way, the most adequate solutions for a specific project.

Two case studies are presented in order to compare this systemic vision of sustainability with concrete housing projects in two different contexts. The first case concerns nine social houses in a small French village. The construction uses wood and hemp for the structure and the insulation of the walls. The heating is partly generated by a geothermal source. The promoter and the architect were both convinced of the importance of environmental issues but not the inhabitants or a majority of the builders. The second case is a family house with few financial resources but with strong environmental convictions. They assumed all together the roles of promoter, builders and inhabitants.

The results show that the social houses case, with its amount of institutional, economic and time constraints fails in generating cohesion around the environmental purpose of the project. The crucial point seems to be the lack of integration of the inhabitants, which play an important role in the energy consumption. Additionally, the major use of industrialized products makes the products traceability very difficult and therefore the impacts visibility too.

In the case of the family house, the economic constraint was balanced by the possibility to extend the life cycle of the house over the years depending on the family’s needs and resources. A strong social network and the use of local resources (sun, wind, water, and construction materials) contributed to lower the cost of the house. Moreover, these factors increased the visibility of environmental impacts. Twenty years later, the house is totally autonomous in energy and water, treating its water and processing its organic wastes.

In conclusion, an attempt was made to shed light on the subtle and invisible line that separates the paradigm underlying sustainability and the one underlying unsustainability. It seems that the "systemic compass for sustainability" may be used to manage housing projects toward such change. By helping to modify the decisions makers' representation and eventually the one of all the stake holders, this tool widens the range of possible solutions.

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She obtained her master degree in behavioral biology from the University of Paris 13 in 2002. Then, she started to work on the sustainable development field with several non-profit organizations before performing another master degree in sustainable development in organizations at the University of Paris 9.

In 2006 she started a PhD on "Indicators of sustainability in housing: a systemic approach of sustainability" at the Centre for Research in Interdisciplinary Studies in Sustainable Development (CREIDD), University of Technology of Troyes. She met the groups GIROS and AFSCET and discovered with a big enthusiasm the wide world of system sciences. She defended her thesis in July of 2011.

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Organizational Resilience: A Crisis Response?

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Abstract: *Currently, organizations evolve more and more in a context of turbulences and shocks. The capacity to bounce back in these situations concerns resilience. Most of the time, it is evoked in trajectories of personal life. We start from the assumption that resiliency also fits in organizational contexts. How to manage turbulences and destabilizing events is the challenge. New organizational designs relay the current ones and new paradigms will emerge.*

Keywords: crisis; types of resiliencies; individual identity; organizational identity; toxic handler; sensemaking; boucing back

Acknowledgement: My thanks to Andrée Piecq for exchange of views on resilience and functioning of human systems, to Gilles Teneau for these years of collaboration and research dedicated to organizational resilience, to Pierre Bricage for his input on resilience in living systems and to Guy Gaspard for the sharing of organizational management experience.

We are engaged in major changes and ignore the outlines of those. This phenomenon is amplified by globalization. Individuals and organizations are confronted with many upheavals. The challenge relates clearly to survival of organizations; economic and social resilience constitute an important key of it. The capacity to bounce back in these situations concerns resilience. It is not it has been part of human behavior for long. Most of the time, it is evoked in trajectories of personal life. We start from the assumption that resiliency also fits in organizational contexts. New organizational designs relay the current ones and new paradigms will emerge. Let us approach resilience, behaviors in a crisis context, resilience trajectories and perspectives in a turbulence environment.

1. Plural resiliencies

Let us note that the concept can be found in various disciplines. In the beginning it occurs in the physics sciences. By analogy the concept was extended to other disciplines such as metallurgy, psychology, ergonomics, ecology, economy, data-processing… In the current language resilience is defined as the art of bouncing back. Let us successively keep the definitions given by Boris Cyrulnik and the definition given by Stephan Vanistendael and Jacques Lecomte. The first one defines it as “the capacity to succeed in living and to grow in an acceptable way in spite of stress or adversity which normally entails a serious risk of a fatal outcome. The second one defines resilience as “the capacity of a person or a group to be projected in the future in spite of destabilizing events, difficult living conditions, sometimes severe traumas.” They highlight the individual, the group and the community role. They take into account the interactions between the individual and the environment which surrounds it. It is a combination of interior force, support of outside and training starting from the gained experience. The organization can adopt different attitudes with regard to disturbing or disruptive events (Teneau & Koninckx, 2010, pp. 21-29). Experienced as a threat they carry perspectives for deconstruction, while experienced as an opportunity they open the perspective for creation or rebuilding.

2. The context

In the wake of the changes and ruptures, we note a significant number of people and teams battling against stress, obsolescence and burnout symptoms. The professional environment and careers paths are more than ever chaotic. How do individuals behave in situations of disequilibrium? The concept of resilience highlights the capacity to anticipate and rebound towards difficult situations. Systemic constitutes an interesting contribution to approach resilience within organizations. In the "General Systems Theory" Ludwig von Bertalanffy studies systems in equilibrium, i.e. systems which are subject to a set of fluctuations which brings them back to the same stable status for given conditions. For systemic rebuilding is connected with the mechanisms of regulation and the processes of homeostasis. How to bring the unit back to its initial state, ensure its survival or find a balance? Practices, habits and rules will play a central role. The mention or the reference to a construction of a completely different nature (another logical level) is rather to connect with "mutations". Indeed, it could be that the internal or external shock could be an opportunity to see the emergence of a new order, a total transformation, a kind of rupture.

3. Behaviors within the system crossing crisis

The upheavals within the organization whatever their number, nature and diversity challenge individuals and teams. According to their intensity, they can take on the appearance of crisis. In similar context, the system to which the person belongs is shaken. The person is challenged at the level of the personal and individual identity. From the moment that identity vacillates, it enters in crisis and a loss of membership settles: (the identity crisis). How actors represent their organization is not immune; organizational identity is also challenged. It is growing over the constant changes taking place within the organization. It emerges from the process of the three components (strategy, management and structure and its implications understood as a sudden "de-idealization" of the organization identity. The deregulation of the organizational identity is expressed among members by feeling confusion and discontinuity of the identity whereas the organizational identity produces sense. Exactly as the identity of an individual in a given social context is largely connected to its role in this context, the identity of an organization is largely related to its mission and its activities to achieve it. This "confusion of identity", as called by Erikson, is an apparent sign of the loss of identity, the "desidentification" of the organization. During these moments of turbulences, what can make sense to the activity is under strain. A deconstruction of sense as well as an attack to the identity take place. A feeling of confusion and discontinuity of the identity can be observed, although this phase of imbalance is not negative or regressive in itself. It may be beneficial, stimulate the emergence of innovations and cause maturation. It joins the Chinese concept of "crisis" represented by a double ideogram meaning at the same time danger and opportunity. Whereas the individual find it difficult to identify and produce sense around the evolution of the organization and to establish continuity, a space for an identity redefinition opens. It makes it possible to regard the periods of turbulences and crisis as moments of intense transitions during the gestation, amplification, demonstration and regulation of the crisis. During this crisis crossing a choice appears: turn inward and let the event take place or exploit the resilience capacity to face it and grasp the opportunity to bounce back. Generally the emotional tensions play a determining role during this period. They influence the representation of the reality. The capacity of individuals or teams to living and developing by overcoming its traumatic events involves ways of resourcing: internal and external. The capacity to review its own routines whenever people are confronted with unexpected and perturbing events is the expression of a reliable organization. For Karl Weick, it supports the presence of a collective conscience stimulated by processes of connection and relations between the individuals. Hence the interest to observe interactions, within the system. The capacity to bounce back within the organization is carried out by: the "toxic handlers". They take on them the "sufferings" of the actors of the company. They take part in the installation of resilience strength. Thanks to their capacity of compassion, they can become a central or single point of contact within the organization. They are catalysts of their own suffering and the organization sufferings. With the compassion we enter a mode of commitment in the action, which is characterized by a tension between “calculation” and “off - calculation” (Teneau & Koninckx, 2010, pp. 171-176). The emergence of a kind of “psychological contract” can be observed in which the individual and the organization can invest, namely the commitment. The commitment is based on a kind of partnership “emotion - thought”. The mental models are also to take into account because those influence the behaviors, the rules within the organization, as well as the commitment of the actors.

4. Resilience trajectories

Resilience constitutes an open door with the rebuilding of the individual and organizational identity. The context, the situation, the events register resilience through time. This one is not obtained by decree and does not operate at once. This is why it is more adequate to speak about “pathways of resilience”. Resilience is a process in opposition to an acquired status. Far from being linear, this process includes distinct phases and sequences. The rhythms can be different and flashbacks are available. The needs of the “bereaved” are specific to each stage. Never definitively acquired, resilience is a capacity which results from an evolutionary dynamic process during which the importance of a trauma can exceed the resources of the subject. We talk about “trajectory” of resilience and distinguish resilience of type 1 from resilience of type 2. The resilience of type 1 deploys the capacities to mobilize the resources in order to find a state of balance anterior to the shock and within acceptable limits. The capacities to mobilize the essential resources to cross turbulences of the situation and to find a new balance in rupture with the previous situation concerns the resilience of type 2. The trajectories of resilience, far from being isolated, fall under an organizational context and constitute a part of change. The evaluation of the system makes it possible to identify suitable strategies according to the phase of the crisis.

5. Conclusions

Resilience is registered in the history of humans and their organizations. The challenge is the management of the destabilizing event and the creation of favorable conditions at its emergence. It is essential and can be regarded as a “driving resource”. Resilience gives access to a particular glance on the organizational behaviors. The contributions of the trajectories of resilience invite to another reading of change and crisis management as well as management of continuity.

And to conclude, a free translation of Pierre Bricage’s words at a conference devoted to survival of the living organisms and the adaptation of human systems to change and aggression: “Any living organism is an indissociable organized system from their survival environment. Permanently, any living must re-build its organization and re-create its autonomy; it is unceasingly dependant on its external environment of survival in which it regenerated continuously itself. In this environment, it draws matter, energy and information; it is integrated within a food chain. Before being able to survive itself in its descendants, it must initially stay alive and survive, by extending its existence beyond the unbearable events which can involve its disappearance.” (Bricage).

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Guy Koninckx

A wide experience in the human resources management gave me access to different organizational cultures. My approach is based on systemics. I put my expertise to teams and organizations faced with difficult situations and contexts of changes. I intended the emergence of individual and organizational resoures. With Gilles Teneau, I modeled trajectories of organizational resilience. The results were published 2010. Member of G.I.R.O.S and S&O A.S.B.L (Belgium).

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Symposium S. Design and Self-Organization in the Emergence of Effective Organizations

Chair: Raul Espejo, World Organisation of Systems and Cybernetics

The purpose of this symposium is reflecting, among other aspects, upon policy-making, values, technologies, relationships, communications and interactions in the emergence of effective organizations.

Most organizations, whether commercial enterprises, third sector associations, public sector institutions, cities, multi-institutional set-ups and, in general, all kinds of organizational forms are the outcome, to different degrees, of design and self-organization. The focus of this symposium is on the clarification of 'different degrees'. We can say that some organizations, such as government institutions, are likely to need a good deal of design, while community organizations, such as cities and NGOs, are likely to be dominated by self-organizing processes. However, both types of organization structures have advantages and disadvantages. The development of free for all, Wild West type of cities is likely to be painful and costly, at the same time, imposing formal, rigid, structures to their development is likely to make them unattractive and unresponsive; to a large degree they are the outcome of local problem-solving dependent on location, resources, politics and so forth. On the other hand, too strong planning and control of government bodies is likely to make them unresponsive. But their unregulated development is likely to support corruption and chaos. In either case, the emergence of effective organizations requires designing top-down structural and processual innovation and enabling bottom-up high complexity self-organization processes. In between the extremes of cities and public institutions we may think that market oriented enterprises offer a good balance between design and self-organization. For instance, the current restructuring of institutions such as the National Health Service in England appears to be driven by the belief that stronger markets are likely to increase its performance. There is also the belief that the old designs, built on centralized structures, are the culprit of its current under-performance. The question is to what degree policy-makers recognize that free health services for all the population imply both organizational design and flexible markets. Increasing our understanding of how to deal with these two aspects is the purpose of this symposium. This Symposium wants to achieve a good balance between theoretical and empirical approaches to the issues of design and self-organization.

Markus Schwaninger: *Towards Optimal Organizational Designs: The Fractal Dimension of Self-organizing Systems*

Hans Losscher: *Leadership and Chaos*

Penny Hart: *Using an Interpretivist Methodology to Investigate Knowledge Sharing in a Research Establishment*

Tom Ryan: *Working 'Cybernetically' at Organizational (Re)design*

Louis Klein: *Exploring the Organisational Collage of Memetic Paradigms – What can we know?*

Helmut Nechansky: *Problems of Organizational Cybernetics beyond Beer's Viable Systems Model*

Zoraida Mendiwelso-Bendek: *Supporting Civil Society's Self-Organisation*

José Perez Rios & Xosé Lois Martínez Suárez: *An Organizational Cybernetics Approach to University Urban Planning*

José Bermeo: *Designing Effective Organizational Conversations*

Raúl Espejo & David Hooper: *Communications, Interactions and the Re-structuring of the English National Health Service*

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Towards Optimal Organizational Designs: The Fractal Dimension of Self-organizing Systems

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Abstract: *An innovative approach to the assessment and design of organizational structures is proposed. For that purpose, the measurement of the fractal dimensionality of living organisms, as used in biology, is applied to social organizations. We ascertain the fractal dimensionality that is optimal in terms of the adaptiveness and fitness of organizations. On that basis, a Theorem for an Optimal Structuring of Organizations is formulated. This theory furnishes a benchmark by which organizational diagnosis and design can be improved.*

Keywords: organizational design; fractal dimension; Hausdorff-dimension; team syntegrity; optimal organizations; General Systems Theory

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1. Introduction

The search of optimal structures for organizations has been an ongoing concern in the social sciences. Optimization theory has provided solutions, but these have always addressed very specific organizational problems, not the issue of overall optimality in terms of the adaptiveness and fitness of the organization as a whole. The purpose of this paper is to propose a new approach, grounded in system theory, for assessing and ultimately also for pursuing such a general optimality of organizational designs.

2. The Question and Established Modes of Dealing with it

The question “Are there optimal structures for organizations?” has recurrently been posed in this general form. The answers have varied, but to date the tenor has been: “No, there is no generally optimal structure. Probably there is an optimal structure for each organization. But we are still looking for a solid theory to ascertain that.”

In the past, the question of organizational optimality has been considered discussible only in very specific and therefore limited contexts. The more famous examples are linked with the optimization of *organizational processes*, e.g. routing problems, resource allocation problems, and control problems. Applications of this type have resulted in substantial improvements as far as the economic use of scarce resources is concerned. The types of problems of *enduring structures*, which have been studied in terms of optimization, are different:

- *Single-objective optimization:* Under this title the classical types of optimization can be subsumed. A typical case is the question of the optimal span of control in a hierarchy of agents with largely uniform tasks (e.g., the optimal number of salespersons in service centres for a market).

- *Multi-objective, multi-parameter and multi-level optimization:* Large and complex logistic systems may call for "multiple-issue" solutions which allow for an overall optimum, taking into account different objectives at the same time (e.g., a postal system where cost, time and ecological performance may be the pre-eminent criteria, and where a structure of distributive centres with several levels may be considered). Solutions for this type of problem involve multi-objective, as well as multi-parameter and multi-level optimization in a combined mode.

It must be noted that only a subset of the optimization techniques can provide "optimal solutions" in the strict sense of the word. Most of the more complex solutions mentioned are numerical and only approximate optimality. In other words, it is known that these solutions are close, often very close to the theoretical optimum, although that theoretical optimum remains unknown. The exact boundary between the cases with "optimum" solutions and those with "close to optimum" solutions is given by the theoretical limit of feasible computation, which establishes the physical limits of analysis. Essentially, the use of heuristic methods is motivated by the question as to whether the decision problems which are part of these optimization problems are "NP-complete"[1]. This means, to put it in a nutshell, that an exact solution of a given optimization problem is possible if one can construct a polynomial algorithm which can solve all the decision problems of the complexity class in focus (cf. Garey/ Johnson 1979, Wegener 1993).

Another approach to the search for optimality has been multidimensional structuring. In principle, optimization can be applied to multi-dimensional problems, as has been said: Multi-objective optimization is a case in point. When we talk about "multidimensional organization" we mean something different: We indicate the simultaneous structuring of an organization according to different structuring criteria. Even though multidimensionality has contributed substantially to absorbing complexity, the question of an optimal degree of dimensionality remains open. In fact, it has barely been addressed.

3. Idea for an Innovative Approach and Hypothesis

If we ask "What dimensionality is optimal?", organization theory itself cannot provide us with satisfactory answers. We have to take recourse to the natural sciences, as General Systems Theory and Cybernetics have done more often[2]. Once more biology appears to be a reliable source of knowledge.

This approach is based on the following idea: If the *fractal dimensionality* (known as the „Hausdorff-dimension", in acknowledgement to its originator (Hausdorff 1918) of living organisms is optimal (as proposed by biology; see: M. Sernetz), and if optimal structures are invariant across different domains of reality (as claimed by systems theory; see: J.G. Miller and S. Beer) then the *benchmark* for the optimality should be the size of that dimensionality.

Recent biological studies teach us that living organisms (plants, animals, humans) are structured in a fractal mode: Their metabolism, breathing, blood circulation and other vital functions are optimized by these fractal structures.

The dimension of a fractal can be ascertained by determining its conventional measures with the help of increasingly fine yardsticks, and by ascertaining how much the measures grow as a function of this refinement. Real biological objects can be measured in this way, whereby their fractal dimension can be determined. Biometric studies have ascertained that the metabolic activity of living organisms follow a law of power, expressed by the following formula, which has been derived from empirical evidence (after Sernetz/ Justen/ Jestczemski 1996, Jestczemski/ Bolterauer/ Sernetz 1997):

$$M = L^D, \text{ where } 2{,}2 > D > 2{,}3. \qquad (1)$$

M is the metabolic activity, measured as the organism's throughput in Joule per second, and *L* is the length of the organism. *D* is the fractal dimensionality of the organism. On the basis of measures of multiple species, Sernetz and his team at the University of Giessen ascertained an

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[1] NP stands for *nondeterministic polynomial time*.

[2] Cases in point are Anatol Rapoport's exemplars of mathematical modeling in biology and the social sciences, as well as James Grier Miller's *Living Systems Theory* and Stafford Beer's *Viable System Model*.

allometric exponent of b=0,74, measuring the progression of throughput in Joule per second, as a function of body volume in litres. Expressed by the length instead of the volume, the applicable exponent is D=*3b=2,22*, which denotes the growth of the metabolic rate as a function of the length of an organism. On the assumption that the extant living organisms are optimally structured, Sernetz concludes: An optimally built organism must be 2,22-dimensional (Sernetz 2000). In other words, according to this theory, for optimally built organisms the law of power must be:

$M = L^{2,22}$. (2)

If the structural laws governing the behavior of social organizations and living organisms are the same, and there is a large body of evidence indicating that they are, then we can make use of a powerful isomorphy (i.e., structural invariance):

Similarly to an optimally built organism, an optimally conceived organization should exhibit a dimensionality of about 2,2 to 2,3. Then, the hypothesis to be tested is:

An optimally conceived organization shows a dimensionality between 2,2 and 2,3.

4. Test of the Hypothesis

The first approach taken has been to test whether a structural arrangement already proven or at least considered optimal is in accordance with the hypothesis.

The organizational model chosen for this purpose is Beer's *Team Syntegrity* model, a structural framework for an optimal structuring of interactions and communications in large, self-organizing groups (Beer 1994). At this stage, Team Syntegrity has been extensively tested; about 500 applications have been realized, several of which have been explored scientifically (Examples: Beer 1994, Hechenblaickner et al 1995, Espejo/ Schwaninger 1998, Schwaninger 2003). By and large, the theoretical claim that the Team Syntegrity architecture is prone to optimize interactions and communications in large groups (cf. Jalali 1994) appears to hold also on empirical grounds.

The test of the hypothesis has been carried out in terms of a calculus of the fractal dimensionality of the Team Syntegrity architecture. The calculus is based on the icosahedral architecture for an "infoset" (i.e. a group of participants) made up of 30 individuals. These are represented by the 30 edges of the icosahedron and organized in 12 groups (which correspond to the vertices of the icosahedron). Each individual is a member of two groups as a player and of two further groups as a critic, as well as an observer of certain groups of which he or she is not a member. The details of this calculus will be presented in Symposium S of the conference

The result of this calculus is surprising: The dimensionality of the Team Syntegrity architecture amounts to 2,1658. This result corroborates the hypothesis so strongly, that the initial hypothesis can be slightly revised. Now a *Theorem for an Optimal Structuring of Organizations* can be proposed. It says:

1. **The fitness of organiziational designs can be assessed on the basis of their fractal dimensionality.**
2. **An optimal organization structure shows a dimensionality of approximately 2,22**.

5. Conclusions

The *Theorem for an Optimal Structure of Organizations* opens up new prospects of a more rigorous assessment of models of structure proposed by theories of organization[3]. But it also enables a better-founded evaluation of concrete structuring options, as well as a theory-based design and implementation of structural models in practice. The implications for the methodology of

[3] The theorem formulated here should be submitted to further tests. In addition, follow-up research should address several important questions, two of which shall be pointed out here. The first question is: What are operational measures of fractal dimensionalities, and how can they be achieved? The second question is: To what degree can the optimal dimensionality vary as a function of the properties of an organization, such as the cohesiveness or diversity of goals, values and preferences of its members?

organizational structuring could be substantial: The optimal Hausdorff-dimension furnishes a benchmark by means of which the better variants can be sorted out.

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Leadership and Chaos Theory

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Abstract: The purpose of this contribution is to make clear what it means to practice leadership in accordance with chaos theory and complexity theory. Sometimes these concepts will be underpinned by insights of the Viable System Model and Viplan.

Keywords: leadership; chaos theory; self-organization

1. The emergence process

The purpose of this contribution is to make clear what it means to practice leadership in accordance with chaos theory and complexity theory. First we will discuss some concepts like attractors, non-linearity, self-organization, the edge of chaos and paradox. Sometimes these concepts will be underpinned by insights of the Viable System Model and Viplan.

Chaos theory is an explanation of the behaviour of a system that can be described by nonlinear equations where the output of one calculation is taken as the input of the next. After multiple iterations the calculation takes on the characteristics of non-linearity and becomes specifically unpredictable while at the same time remaining in a determined pattern. The chaotic patterns that emerge seem to be bound by the influence of a "strange" attractor. The behavior within the system is a paradox in that it defies specific long-term prediction while at the same time demonstrating consistent long-term patterns of organization (Burns, 2002, p. 44).

According to Goldstein et al (2010) emergence is a cyclic process whereby one experiment is tried, followed by another, and so on, as experiments are extended and interwoven throughout the system. The seeds of emergence through recombination become established in a local, limited regime, and only then can make onslaughts into regions that more and more cut across the whole space.

In general […] the emergence process can be understood in terms of four non-linear phases of activity. These four phases are:

Disequilibrium Conditions: the emergent order occurs only when the system is in a state of criticalization or disequilibrium. In organizations this can be done by recruiting new sources of energy (e.g. members, suppliers, partners and customers), by shaking up the organization and by providing new sets of challenges that cannot be mastered by hewing to existing procedures. Another way to trigger these conditions is by integrating a high degree of diversity and difference, that is, informational differences into a single program disrupting radically participants existing patterns by questioning.

Amplifying Actions: the key is to live with –and even embrace- the discomfort of disequilibrium. A certain threshold of disequilibrium must be crossed. Marion (1999) calls this a critical mass.

Recombination: here they refer to the Gaia theory of Margulis and how inventors work.

Instituting Stabilizing Feedback: as top-down and bottom-up emergent structures interact, self-reinforcing feedback strengthens those structures that support the system's sustainability, while negative feedback suppresses structures that don't. Both positive and negative feedback from the market constrain an emerging business venture, influencing which internal processes survive and which will not. These theories emphasize circular causality; the environment influences the system that in turn influences the environment.

2. Model of the Chaotic Organizational Environment

The question remains: What is the use of all these computations for managers and leaders in practice? System thinking can help explore answers to this question. Espejo & Reyes (2011, p. 17) state that system thinking is a way of thinking that sees phenomena in context. They distinguish between the black-box type of description of systems and the operational description of systems, which are complementary. In the operational description control is understood in terms of self-organization and self-regulation. But black-box type of description is driven by control. This is a loaded term often related to hierarchical relationships and structures (p. 99). That is why they use the term cohesion function.

A strange attractor can be considered as the ultimate purpose and core values of systems (Burns, 2002). Within the Strange Attractor Zone the system continuously self-organizes and invents ways to articulate its core values as it fulfills its primary purpose in response to a dynamic environment. The collection of agents engaged in this primary purpose, using the agreed upon schema to fulfill it, is called the legitimate system. Negative feedback loops prevail in this system. The legitimate system evaluates productivity of the agents and their schema (rules) through negative feedback loops. Self-organization, however, is not hierarchically driven. Instead it is a process of system transformation that is self-generating. Self-organization happens when a work group or an organization is facing a challenge and is allowed to respond to that challenge in a spontaneous, unshackled manner. The issue, then, is not how to pressure a system to change, but how to unleash the system's self-organizing potential to meet a challenge (Goldstein, 1994).

According to Goldstein (1994), the boundaries of the nonlinear system must be firm and non-permeable enough to keep the system intact as a unique system. One can also say to keep the identity (what it is) intact. Paradoxically, however, the boundary also must be permeable enough to allow nonlinear conditions from the environment to affect the system. The boundaries contain the internal processes.

To summarize, self-organization takes place in nonlinear systems if obstacles are removed and boundaries of the system are firm yet permeable enough to allow exchange with the environment. However, self-organization will take place anyway as people find their way around as control freaks know to their despair. According to Marion & Uhl-Bien (2002) in what they call Complex Leadership, a fundamental tenet of this kind of leadership is its movement away from control. More specifically, transformational leadership sees control as top down, and at the discretion of the leader; complexity theory sees control as bottom-up and imbedded within the dynamics of the system, and is enabled by the leader.

In the VSM there is a System 3, called Cohesion at each level of recursion. Here autonomy and self-organization of the primary activities and cohesion of the whole system are complementary.

3. The do's and don'ts of Leadership

Now that we understand better some 'abstract' concepts beyond chaos theory, let us see what is involved in leadership from the perspective of variety engineering (see Figure 1 and Losscher 2011). This is a loop that needs more research.

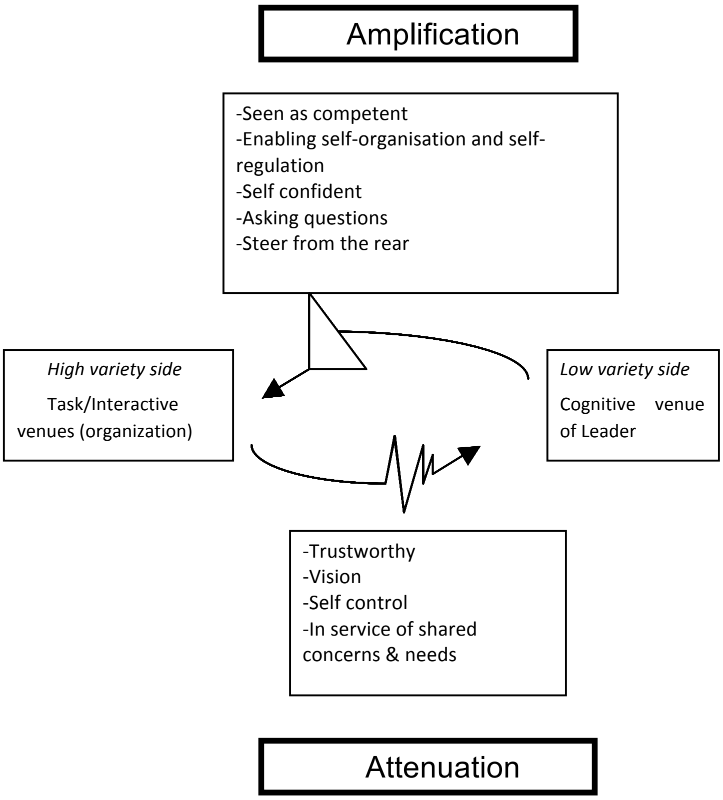

Figure 1: Leadership in cybernetic terms (Losscher, 2011).

First the do's, also based on Goldstein (1994) and Goldstein et al. (2010):

-Shortening the path length between all the nodes of any network can be achieved by adding 2 percent more links randomly than already exist.

-Require firm but permeable system boundaries for self-organizing.

Providing these conditions for self-organizing is part of steering from the rear. This can for instance be done according to the VSM and Viplan insights. Marion's rules of thumb can be helpful to get a feel for where the attractors might be. Once the big picture of the legitimate system is known one can go into more detail. Paying attention to the development of shadow systems and being alert for weak signals and small changes is important here.

-Interrupt equilibrium-seeking processes

-Amplify departures from equilibrium

-Challenge a system to restructure its mode of organization

-Contain an element of unpredictability

-Instead of consensus-seeking as the means toward participation, non-consensus-seeking by difference questioning can lead to spontaneous participatory structures. Difference questioning emphasizes the differences (of opinion) between people.

-Activate nonlinearity to prompt system change and let the system seek its level.

Second the don'ts, based on Goldstein (1994):

-Do not impose change hierarchically (the VSM is non-hierarchical in nature).

-Forget about 'unfreezing' and 'refreezing'. In daily life this is highly unhygienic.

-Instead of emphasizing planning, change is an evolving strategy utilizing chance, accidental events, serendipity, play and even absurdity ("Chance favours the prepared mind", HL).

This list emphasizes why courage in leadership is an important issue. But it does not mean that amplifying self-organization is the equivalent of a 'laissez-faire' leadership style.

To the contrary; it is hard work not knowing where it will end.

More rigorous research and experimentation have proven that emergence hardly comes about spontaneously – instead, it demands rigorous containing, constraining and constructional operations. Accordingly, our interpretation of leadership's role in emergence is not passive, but instead is active and generative (Goldstein, Hazy & Lichtenstein, 2010, p. 14).

4. Conclusions

Leadership is finding a balance through variety engineering, placing the right kind of system (nonlinear) under the right set of circumstances (discomfort of disequilibrium) and making clear the context (boundaries) and the content (difference questioning). It also means being sensible for small changes and weak signals that can have a big impact.

Being self-confident results from being aware that some things will never (or hardly) happen. As Beer and Ashby already stated, if a constraint exists one can benefit from it.

In the legitimate system it is important that internal agents know and agree with the purpose, core values and the boundaries of the system. In other words the agents have to know the context and content. For the rest it is facilitating the conditions and challenging the system where emergence, self-organizing and self-regulation can take place and not getting in the way.

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Using an Interpretivist Methodology to Investigate Knowledge Sharing in a Research Establishment

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Abstract: *In knowledge communities, the opportunity to share ideas may be limited (by distance, culture, power relationships or even access to means of communication). Therefore this procedural knowledge ("know how") may be translated into propositional knowledge ("know that") for sharing more formally. However, there are difficulties in communicating what people "need" to know and not least, in convincing those with power of the value of that knowledge.*

A research organization provides knowledge services to its clients, both "knowledge as a commodity" (reports, papers) and "knowledge as knowing, practice" (access to subject experts, sharing of expertise in projects). Knowledge is viewed at once as a commodity and also as praxis; both aspects of knowledge need to be used effectively, to meet the organization's remit and help justify its continued existence. Strategies and procedures have been created to take advantage not only of explicit knowledge in a "knowledge as a commodity" sense, but also to attempt to capture what is "known and used". However there is a strong feeling that this tacit knowledge, although important, is difficult to grasp and it is difficult to justify its value within and outside the organization.

There is concern within the research organization with issues which influence how knowledge is defined and used. Their attempts to capture and share knowledge expose an objectivist view of "knowledge as a commodity", in the use of repositories of published works, databases of contacts. This view influences mechanisms set up to share "knowledge as practice": the use of communities of practice, subject experts, e-profiles and blogs. This is evident in how they consider the possibilities of capturing and using tacit knowledge; subject experts are considered to be "resources" from whom this knowledge is to be extracted. One of their issues is how to make these knowledge management devices more effective. Another issue is how far capturing tacit knowledge is possible within the constraints of the organization.

We suggest in this paper that an interpretivist approach will be more effective in helping those involved to think about what knowledge means for them, how effective current knowledge sharing mechanisms are, and about the checks, balances, obstacles, external influences and power relationships which affect their points of view and their ability to improve the sharing of knowledge as they see it. The interpretivist approach focuses on developing shared understanding in specific contexts, interpreting human experience, and giving participants ownership of their own investigations. The value of interpretivism is in the more nuanced considerations of: boundary, appreciation, the value of surfacing the hidden assumptions and engaging in learning.

Taking as a starting point these issues around knowledge sharing in the organization, an action research study was carried out using the Appreciative Inquiry Method (AIM). This methodology is based on the work of Vickers (1965) on appreciation, and its emergence from the norms and values of participants in a given situation. Appreciative Inquiry Method (AIM) is a process of inquiry, in which participants arrive at a shared understanding of the situation of interest. It claims that discovering "tacit" or subjective aspects of knowledge is more appropriate to addressing complex problems than rationalist approaches. The methodology consists of framing an issue or question through a series of interactions with participants and identifying (with accommodation of differing views) relevant systems within the situation of interest. Activity models are produced for those thought to be most relevant to the area of focus. These identify the situation which ought to exist and are used in comparison with the existing situation, as the basis for further learning and modeling. AIM adopts tools and techniques from Soft Systems Methodology (SSM), developed by Checkland (1981, 1999) but differs from SSM in important respects. The goal of action research conducted using SSM is to do with possible actions that can be taken in the situation, with the cultural and political dimensions acknowledged, but not addressed in detail. AIM is concerned with developing participants' appreciation of the situation, with more consideration given to the power relationships, and more emphasis on the cultural and political feasibility of action.

The study uncovered many further issues. From the participants' discussions we could see that both definitions of knowledge were in use. There were many repositories and transfer structures for "knowledge as a commodity", but the participants emphasized the importance of "knowledge as practice", both to show value for their clients and to work most effectively. The participants felt that the there was a lack of "need" to distinguish between information and knowledge in parts of the organization, and this led to a culture which de-emphasized the importance of "knowledge as knowing and practice".

The contribution of the "knowledge as practice" was felt to be undervalued by the clients and fund-holders in the organization, and this led to increased cost and inefficiencies where processes had to be repeated to recover lost expertise.

The recognition of value of the knowledge by clients and fund-holders could be fed into budget and processes, and used to drive improvements in effectiveness of knowledge sharing.

A tacit assumption by the participants was that tacit knowledge itself could be captured or transferred. The participants recognized the need for transfer but did not articulate how far this was possible for tacit knowledge. This was felt to be a particular issue for succession planning. The value of tacit knowledge was a thread throughout the study: its value to the participants and what they thought its value ought to be for the organization.

Examining these issues led to the following realizations: In this organization the objectivist viewpoint, seeing knowledge as a commodity, can predominate, even in situations where there is recognition of the benefits of seeing knowledge as knowing, practising. The lack of clarity between defining knowledge as a transferable object or as knowing, practicing, leads to ineffective use of structures to promulgate it. Conflicting or orthogonal views on what constitutes knowledge and how it can be used or shared hinders purposeful action.

The participants' power to change the situation is constrained by policies which set the environment in which the organization exists and its budgets. The expectations of its clients are also a limiting factor. Where power to change lies outside their domain, purposeful action is limited to how they can influence the power holders, and this depends also on their position in the hierarchy. In contrast to this realization, participants discovered actions which are within their control. Motivating and rewarding people for sharing information, setting examples and expectations about sharing, and increasing access to new sharing mechanisms were all discussed. The participants acknowledged that the use of AIM had provided them with a tool to appreciate their knowledge sharing practice.

Keywords: knowledge sharing; appreciative inquiry method; appreciation; definitions of knowledge

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Working 'Cybernetically' at Organizational (Re)design

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Abstract: *This paper explores the conceptual synthesis of cybernetics and design theory as the basis for redesigning organizations*

Keywords: organization design; cybernetics; management domains

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In his writings Stafford Beer continuously reminds us that an organisation is perfectly designed for what it does. If we need to change what it does, we need to redesign it. Much of organizational design is redesign of existing organisations.

What an organization does determines its viability within its environment. To sustain viability in a continuously changing environment an organization needs to continuously change what it does implying it must continuously redesign itself. Redesigning is central to sustaining viability. Organizations are social systems and as such much of what they do can be seen as creating (in some cases destroying) value for its stakeholders

Stafford Beer's Viable Systems Model specifies the necessary and sufficient set of interdependent management systems needed to sustain organisational viability. These functions are designed to interact systemically to realize (make real) sustainable value for its stakeholders. Drawing on the work of Beer and others, we can construct four measures that provide indicators of the degree to which an organization is able to create sustainable stakeholder value (Beer, 1985) (Espejo Raul; Harnden Roger, 1989) (Hoebeke, 1994) (Espejo & Schwaninger, 1993). These are:

1. *Actuality,* which refers to the current value produced by the organisation 'measured' in terms of the:
    - required throughput time,
    - volume requirements,
    - quality requirements, and
    - budgeted costs.

   Actuality is part of the operations management domain and is concerned with managing the present using existing resources under existing constraints. It is about how well the current design is being managed.
2. *Capability* refers to the potential value that the current design of the organisation is capable of producing given its current design and constraints. It is concerned with fully developing actual value production levels to the potential value producing capabilities of the current design within current constraints in terms of:
    - throughput time,
    - volume,
    - quality and
    - costs

Capability is also part of the operations management domain and is about eliminating the waste associate with the Actuality level of performance

3. *Potentiality* refers to the future value an organisation can produce by "loosening" its current constraints. It is concerned with designing and developing potential value producing processes of the future. It is part of the strategic domain and its activities are largely about:
    - engagement with the environment with a view to "loosening" the current constraints under which the organisation operates
    - engagement with stakeholders and their changing needs and value systems with the view to identifying new value creating possibilities.

The viability of the new value producing initiatives is determined by their:

- desirability among stakeholders to embrace the new initiative,
- feasibility as a measure of the stakeholder commitment required to make the new initiative work,
- transferability as a measure of how well the new initiative can be transferred across the operation's domains, and
- systemicity as a measure of how well the new initiative interfaces with other domains of the organisations.

The fourth measure is not explicitly covered by Beer, but is covered to some degree by Espejo & Schwaninger (1993) and Hoebeke (1994) and is about normative management. Normative managment is about engaging with multipe stakeholder groups with diverse and opposing world views in a process of promoting the viability and the legitimacy of the organisation. It is essentially about and shaping the future. I usethe term *Normativive capability* to describe the fourth measure which reflects the state of the following attributes od an organisation:

- generativeness- the ability of the organisation to develop new approaches, langiuages and beahviours in dealing with the organisation's stakeholders in its natural and cultural environment,
- tolerance of mutiple and conflicting world views and value systems,
- dialectical capability-the ability to build trusting relationships with stakeholders holding conflicting worldviews and value systems,
- congruence- the ability to shape new worldviews and value systems of is management that are grounded in their own humanity and its traditions

Krippendorff (Krippendorff, 2007) adopts a cybernetic approach to design that recognizes a spectrum of design activities ranging from technology-centered design to human-centered design and links these to first-order and second-order cybernetics. Fig 1 graphically illustrates the embedded relationship between first and second order cybernetics

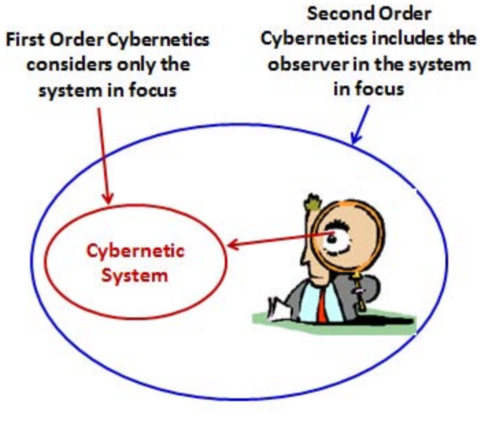

Fig 1 – The Embedded Relationship between First and Second Order Cybernetics

Glanville follows a similar argument by contrasting the design approaches advocated by Simon, Rittel, and Gedenryd. With Krippendorff he argues for strong parallels between the spectra of cybernetics and design. Glanville presents cybernetics as the basis of a design theory. Particular attributes of these design approaches that are relevant here

1. Simon: Design is contingent and focuses on what could or should be. The designed artifact operates as an interface between the system it is a part of and its environment
2. Rittel: Design as argumentation
3. Gedenryd: Scenarios of the designed artefact at work as an interface for the system he is a part of.

This perspective of the embedded relationship between these design approaches is illustrated in Fig 2

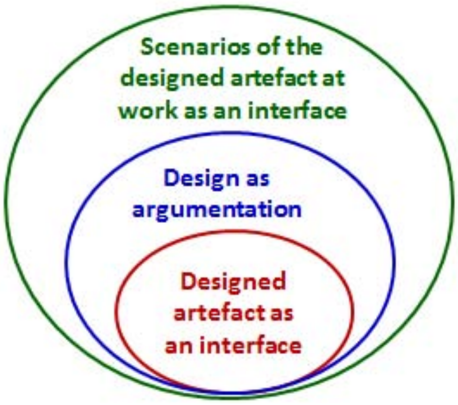

Fig 2 The Embedded Relationship Between these Design Approaches

My synthesis of these two positions is presented in Fig 3.

Fig 3 The Parallels Between Cybernetics and Design

Building on the work of Boland et al. (Boland RJ Jr et al, 2008), Roger Martin has strongly promoted the idea of 'Design Thinking' (Martin, 2009) as an integrative approach to management. I prefer the term design based management. The implication is that design is way of managing and needs to be integrated in to management practice. Koria et al (Koria, Graff, & Karjalainen, 2011) present Hassi and Laakso's elegant model characterizing design thinking in Fig 4. This model provides some insight into the attributes of design based managers that come into play in the process of managing as designing.

PRACTICES	COGNITIVE APPROACHES	MINDSET
• HUMAN-CENTERED APPROACH E.g. People-based, user-centered, empathizing, ethnography, observation (e.g. Brown 2008; Holloway 2009; Ward et al. 2009) **• THINKING BY DOING** E.g. Early and fast prototyping, fast learning, rapid iterative development cycles (e.g. Boland & Collopy 2004; Lockwood 2010; Rylander 2009) **• VISUALIZING** E.g. Visual approach, visualizing intangibles, visual thinking (e.g. Carr et al. 2010; Drews 2009; Ward et al. 2009) **• COMBINATION OF DIVERGENT AND CONVERGENT APPROACHES** E.g. Ideation, pattern finding, creating multiple alternatives, (e.g. Boland & Collopy 2004; Drews 2009; Sato et al. 2010) **• COLLABORATIVE WORK STYLE** E.g. Multidisciplinary collaboration, involving many stakeholders, interdisciplinary teams (e.g. Dunne & Martin 2006; Gloppen 2009; Sato et al. 2010)	**• ABDUCTIVE REASONING** E.g. The logic of "what could be", finding new opportunities, urge to create something new, challenge the norm (e.g. Fraser 2009; Lockwood 2009; Martin 2009) **• REFLECTIVE REFRAMING** E.g. Rephrasing the problem, going beyond what is obvious to see what lies behind the problem, challenge the given problem (e.g. Boland & Collopy 2004; Drews 2009; Zaccai in Lockwood 2010) **• HOLISTIC VIEW** E.g. Systems thinking, 360 degree view on the issue (e.g. Dunne & Martin 2006; Fraser 2009; Sato 2009) **• INTEGRATIVE THINKING** E.g. Harmonious balance, creative resolution of tension, finding balance between validity and reliability (e.g. Brown 2008; Fraser 2009; Martin 2010)	**• EXPERIMENTAL & EXPLORATIVE** E.g. The license to explore possibilities, risking failure, failing fast (e.g. Brown 2008; Fraser 2007; Holloway 2009) **• AMBIGUITY TOLERANT** E.g. Allowing for ambiguity, tolerance for ambiguity, comfortable with ambiguity, liquid and open process (e.g. Boland & Collopy 2004; Cooper et al. 2009; Dew 2007) **• OPTIMISTIC** E.g. Viewing constraints as positive, optimism attitude, enjoying problem solving (e.g. Brown 2008; Fraser 2007; Gloppen 2009) **• FUTURE-ORIENTED** E.g. Orientation towards the future, vision vs. status quo, intuition as a driving force (e.g. Drews 2009; Junginger 2007; Martin 2009)

Figure 4 - A three-dimensional framework characterizing design thinking (Koria, Graff, & Karjalainen, 2011, p. 4)

Glanville argues that like mathematics both cybernetics and design are 'meta-subjects' (Glanville, 2007). As well as being subjects in their own right, they are also abstract subjects that can be usefully applied to make better sense of other subjects. The synthesis of cybernetics and design provides can provide a useful meta-framework exploring organization design as illustrated in Fig 5. Such a meta-frame-work makes it easier to integrate other theoretical frameworks into organisation design. We have effectively done this with the Resource Based View of the organisation, Dynamic Capabilities and Institutional Theory. The cybernetic concepts of requisite variety, feedback/circularity and self-organisation have been particularly useful in these endeavors

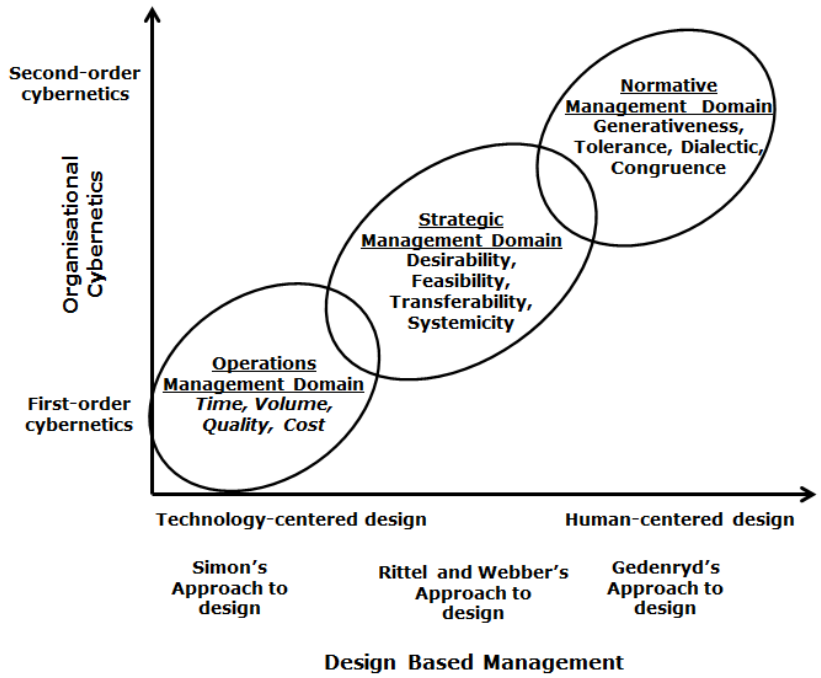

Fig 5 A Conceptual Integration of the Cybernetics of Organisation design

Relating Figure 5 to the idea of the degree of design and self-organisation, I suggest that technology centered design has a hard systems focus and is design "heavy". Human-centered design takes a soft systems approach in creating the conditions for effective self-organisation. The important point is that good design can facilitate self-organisation. Good design therefore underpins organisation viability

In my conference presentation I will describe two case studies that use the model in Figure 5

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Exploring the Organisational Collage of Memetic Paradigms

What can we know?

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Abstract: *How did the organisation become what it is? What makes the organisation not just an organisation but this specific organisation? And what enables the organisation to maintain its identity or to change? These questions introduce a generic perspective, which goes well beyond the structural set-up of the organisation being an organisation. The paper combines on the basis of a systems perspective three additional and very promising facets: narrative approaches referring to the organisation as a collage of stories, the idea of paradigms being the reference for a specific practice and finally memetics a dynamic, evolutionary perspective on social systems, culture and their development. The aim of this approach is to increase our understanding of learning, management and change in organisations.*

Narrative approaches to organisational research had always been capable of shedding some light on the idiosyncratics of an organisation. Engaging in storytelling had added colour to the organisational grey. The organisation as a grand narration, unfolded as a collage of stories. This was a great advance in organisational research and justified pin-pointing the organisation in that famous garbage can model of Grareth Morgan. The garbage can may be a valid generic model of the organisation. In terms of maintaining a specific identity of an organisation, the model is not really satisfactory.

With Giorgio Agamben´s "Signatura rerum" the generic perspective on the organisation is lifted onto a new level resting on the idea of a paradigm being a showcase for further reference. Agamben leads the notion of the paradigm from Ludwik Fleck´s "Thought collectives and thought styles" to Kuhn´s models, methods, and instruments establishing a discipline to Foucault´s "Archeology of knowledge". Agamben overcomes the distinction of deductive and inductive perspectives on paradigms, and focuses the paradigm as the stand-alone showcase, which refers the specific to the specific. Organisational research based on narrative approaches and systemic inquiry was very well able to identify organisational foci of attention. This has been the basis for further analysis of semantics and leading or generic distinctions. Agamben´s idea of the paradigm being a specific showcase adds a new quality to the idea of foci of attention. It allows qualifying a focus of attention as being more. The focus of attention becomes a paradimatic reference for organisational reproduction, for its genesis and development.

Memetics introduce an evolutionary perspective into social systems and culture. It is a specific practice and the idea of this specific practice that fuel the cycle of variation, selection and stabilisation. In this sense the memetic paradigm is the showcase that enables a practice that reproduces a specific paradigm.

In the light of the notion of a memetic paradigm the idea of organisational learning allows a generic focus on organisational practice. It gives substance to social cognitive learning in organisations. The social constructivism of primary socialisation, like being brought forward by Piaget or Berger and Luckmann, can now easily be linked to Bandura´s "Learning from the model" in organisations. It even holds place for Bourdieu´s "Habitus".

In contrast to Nonaka and Takeushi organisational learning is not need to be reduced to the cognitive externalisation of the implicit. Organisational learning can be conceptualised as an implicit learning, which is stabilised on the basics of paradigmatic showcases. It is deriving the specific from the specific. No generalisation needs to be made explicit. It may even go unnoticed. Yet organisational attention needs to focus around these paradigmatic showcases to grant organisational learning and autopoietic stabilisation.

Once Agamben´s idea of the paradigm being a showcase is accepted in organisational research, systemic inquiry is leveraged, and so is the quality of what narrative approaches can provide in research, consulting and managerial practice.

Keywords: organisation; memetics; paradigms; exploration; learning; change; gereric perspective

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Problems of Organizational Cybernetics beyond Beer's Viable Systems Model

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Abstract: *The paper starts from Beer's viable systems model and investigates issues of organizational cybernetics not addressed by it. First some subsystems (dealing with strategic and production issues) are discussed, which may be added as complexly interrelated details to Beer's model. Second and more importantly it is suggested that Beer's model does not cover the establishment and evolution of an organization, and lacks systems able to deal with independent controlling functions, bottom – up correction of performance problems and top-level correction of policy and corporate goal-values.*

Keywords: organizational cybernetics; decision-making; goal-orientation; stability; Viability

1. Introduction

Beer's (1979; 1981) viable system model was developed to address the most important issues of organizations. Beer tried to achieve that with a structure of 5 interacting systems of control. These 5 systems are, bottom up: System 1 for local production control; System 2 for planning and coordinating production; System 3 for improving the processes of systems 1 and 2; System 4 for surveying the environment and developing appropriate strategies; System 5 for developing and realizing a policy derived from corporate goal-values.

To this scheme Beer (1985) later on added a system 3* for quality control, subordinated to his system 3. This later addition by Beer himself suggests that his organizational model may profit from details and additions not included in his original approach. Expanding on previous work (Nechansky, 2010; 2011a; 2011b) the paper investigates such details and additions.

2. Adding Subsystems

First we suggest that distinguishing additional subsystems, not explicitly included in Beer's Model, may ease its application particularly to problems of large organizations.

These subsystems concern primarily various issues of long term strategic activities (like market research, R & D, financial planning, besides general strategic planning) and mid to short term activities (like marketing and sales, finance). Beer would probably place all these activities in his system 4. Similar, but perhaps less complex, problems arise within Beer's system 3 (Here different subsystems have to manage production control, quality planning and improvement - Beer's system 3*, maintenance and budgeting).

The complexity of the relations betweens these subsystems (like available technology and finance limiting adaptability to recognized trends in market, velocity of R & D limiting time to market and determining marketing activities, etc.), requires a detailed consideration of their place in the organization. The question how to control their interrelated performance requires defining goal-values (what these subsystems have to achieve), constraints (means to achieve these goals), and indicators (when the performance of one subsystem endangers another), which we see as not yet systematically analyzed in organizational cybernetics.

Furthermore there are widely indefinable, but decisive, creative strategic processes (like recognizing that a totally new technological development can hurt the company in the future or how to put together available technologies to get to a totally new product). The question, if organizational cybernetics has to tell something to such questions of viability, is still open, too.

3. Adding Systems

More importantly we suggest that additional systems are necessary to understand the emergence, evolution, long term stability and viability of organizations.

3.1. The Foundational System with Initiating and Supporting Functions

The emergence of living systems depends on availability of matter / energy supply. When (1) these resources can be exploited by a system for matter / energy supply, and (2) such a system can continuously provide more usable matter / energy than necessary to maintain itself, (3) it can develop and maintain controller structures, which cannot produce the matter / energy they need by themselves (Nechansky, 2011b).

Looking for similarities to this development in social systems (Nechansky, 2011b), and here particularly concerning the emergence of new organizations, we find: We need (1) a foundational system (an individual or another organization), (2) which can provide an excess of resources (like money) to establish a new production system to make products or services (a "system 1" in Beer's terms), which (3) may support and develop own controller structures (like Beer's systems 2 to 5 and the different subsystems we discussed in section 2. above), once it can produce an excess of resources (like money) by itself.

So we suggest there is a bottom - up development, somehow similar for living and social systems: In both successful functioning of matter / energy supply systems is a prerequisite to develop and maintain complex controller structures. On the organizational level that means the more money a production process can generate, the more controller functions can be maintained, which may further improve the production of products and services.

Beer does neither address this foundational problem, nor any evolutionary paths in his static structural approach.

3.2. Independent Systems with Controlling and Correcting Functions

Corporate controlling has to evaluate the performance of all other systems of an organization. We suggest it should be placed outside Beer's system 4 (strategy), because it has to control that system, too. The same holds for other organizational units for overall process - optimization, which proved to be located better outside any line functions (as in the six sigma approach). So we find here something like systems "5*", with a function not unlike Beer's "system 3*" on a higher level.

On a larger scale, in societal organization, there is some similarity between such controlling systems and independent courts (Nechansky, 2010). But these have to be even less integrated into the whole organizational structure, to ensure the impartiality of their considerations.

There is nothing in Beer's approach to address such widely independent controlling functions.

3.3. Systems for Bottom - up Correction of Performance Problems

There are many examples that systems surpassing a hierarchical structure can improve the stability of an organization, e.g. Ackoff's circular organization (1981), or Kaizen. But the most important forms of systems for bottom - up corrections are works councils. They are coordinating hierarchies to unite the interests of employees and to discuss them, aside the corporate hierarchy, directly with board members or even shareholders, and to pursue them even against these.

In societal organization we find similar systems in labor unions, as bottom up correctives to introduce the interests of workers into the decision making of economic and political leaders.

We talk here about systems to avoid and / or correct goal conflicts between members working within the same or different of Beer's systems. Such goal conflicts can neither be explained nor solved with Beer's scheme, but lie completely outside it (Nechansky, 2011b).

3.4. Systems for Top - level Correction of Performance Problems

Beer's scheme describes a way to execute *given* corporate goal-values, usually determined by external shareholders. A board (Beer's system 5) formulates a policy derived from these goal-values, and tries to realize it. The board may even recognize that a chosen policy does not work and try to realize the given corporate goal-values via another way.

But there remains an important question, which was touched e.g. by Argyris (1982) and Senge (1994), but seems still unanswered by any organization theory: How should an organization recognize that current corporate goal-values cannot be realized, and therefore should be given up. That would require a structure driven bottom up by bad results, but able *to overrule previous top level decisions*, to replace previous goal-values by "better" ones. But what are the criteria to determine "better" ones? Again we face problems of creativity, this time not in strategy development and R & D (as discussed in section2), but on the highest organizational level.

The only practical answer to that question is to fire the men at the top and to replace them by others, in the hope that these are "better". This is done in organizations by shareholders, in societal organization by the people, either in elections or in the street. A theory systematically handling that decisive problem of organizational viability is still missing.

In discussing such open problems of organizations and putting them in relation to each other the paper tries to lay a base for a future improvement of organizational cybernetics.

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Supporting Civil Society's Self-Organistaion

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Abstract: *The relationship between the state and citizens requires programmes of community engagement in which civil society offers a natural space for self-organisation. This is a space where citizens engage with each other in non-hierarchical communications and collective action. But this is also a space where power structures exclude from participating those lacking skills and organisation. This is the exclusion of the most vulnerable in our societies. The purpose of this contribution is discussing how to facilitate civil society's self-organization processes, with the aim of speeding up inclusion and cohesion.*

Keywords: civil society; self-organisation; active citizenship learning

1. Civil Society

Civil Society (CS) refers to a third sector in society, which is a set of not for profit associations, which promote democracy and social justice. These are relatively autonomous associations distinct from the state and the economy, with the self-determination and capacity to engage actively in society (Young 2000). Key aspects of civil society are its voluntary and un-coerced characteristics, often with insufficient attention to its organisation. Walzer (2002) argues that improving this organisation helps increasing the influence of CS, balancing the state and economy, and consequently increasing its relevance in the functioning of our democratic societies.

Citizens' organisation has a great potential in democratic societies but also there is a risk to be hijacked by minorities who over influence the direction and quality of outcomes. Those with resources, power and knowledge to shape discourses and practices can do it to their advantage, increasing power inequalities at the expenses of the weakest (Gaventa, 2011). Those able to participate are the ones who know how the 'system works' and use power structures pursuing their own interests. It is a fact that these groups are more able to obtain this help and this is, in most cases, owing to their organisational competence. Thus, it is essential to help improving the organisational competences of those who are less successful. It is not sufficient in civil society to say ´organise yourselves and go out to work'. The associations, groups, organizations of CS require assistance to protect the interests of the weakest (Walzer, 2002).

The processes of building citizenship are characterised by power struggles, which more than struggles for citizens' rights, are struggles to provide context for citizens to exercise their rights (Janoski, 1998). These are struggles for citizens to have a voice in public decision-making and increase their influence in the State's decisions. There is a need for civil society's organisations to understand the interactions between local, national and global forms of power and the role of citizen-based spaces linking local and the global issues and opportunities (Gaventa & Mayo, 2008)

Citizenship theories have focused much of their attention on studying citizens rights and the balancing of these rights with duties. However, citizenship is not simply a concept that measures rights and duties. It is also a concept for establishing the behaviours and processes that these rights and duties entail. There are many discourses around the concept of active citizenship, from those of governance and decision making to the more contested visions of citizens challenging policies and power. Most of these discourses are about learning processes empowering citizens to take collective action in the pursuit of equality and social justice. They assume inclusive and democratic participation able to recognize citizens as shapers of the decisions that affect them. Active citizenship is about empowering citizens to engage in flexible and diverse learning programmes to take collective actions, increasing their knowledge and critical understanding of those decisions that affect them (Mayo, 2010).

Civil Society is a natural self-organising space, where citizens define their rights and expectations and create new forms of democratic engagement; they learn and change their interactions and relationships with local authorities and policy makers, and make alliances and networks with agents in local, national and global spaces to break down inequalities. Self-organisation is driven by citizens' need to enhance shared values, particularly of social justice. For this purpose self-organisation should help citizens to develop collective inner strengths to have a platform to be outward-looking and promote social justice. But self-organisation, underpinned by heterarchical relationships, is often a chaotic process that fails producing strong platforms. Enabling citizens learning towards pursuing shared values, in non-coercive contexts, is the challenge for civil society. A comparatively small number of associations or groups have the capacity to overcome the obstacles preventing them to produce their socially shared values. Civil Society's learning about reaching inclusion and cohesion for particular issues, expectations and opportunities has been one of the purposes of the Take Part Programme in the UK. . Organising and organisations are necessary to support a more pluralistic understanding of the different forms of identity and citizens' issues, expectations and opportunities; these are the catalysts for the self-organisation of the collectives and groups of Civil Society.

2. Take Part Programme

Take Part is a participatory active citizenship learning space generated in UK by the government in partnership with civil society organisations from 2003. This programme has been taken forward by communities and universities partnership. It has been influenced by Paolo Freire's articulation of social transformative education (Freire, 1972), which involves the learner's attention to the role of collective action, and help them develop their ability to identify, through dialogues, the tensions or conflicts between competing sources of power. It has focused on practices and relationships that allow citizens to balance power structures to facilitate the development of critical consciousness and understanding through cycles of action, reflection and then further action informed by these processes of reflection (Mayo, 2010).

Citizens, as learners, are enabled to explore policy issues that are of particular concern to them and their communities, learning how to engage with decision-making structures and how to organize and communicate effectively to promote social justice, equality and diversity, cooperation, social solidarity and social networks to break down isolation an inequalities. It means also the ability to challenge discrimination, understanding tensions and changes, official processes and learn about negotiation of ideas and purposes.

Take Part has offered spaces for different forms of dialogue, like supporting constructed conversations. These spaces are neutral space to speed up and enable self-organising processes. Examples are area committees, neighbourhood working areas, area forums, citizen panels, local forums for youth, women, mental health or migrant workers, aiming at improving knowledge and skills of diverse actors like parish councillors, neighbourhood workers, community organisers and faith leader (Mendiwelso-Bendek & Herron, 2010).

Take Part evaluations (2006 and 2011) have offered evidence that its activities have widened perspectives of citizenship in community governance structures and leadership programmes (Mayo and Rooke2006) (Miller & Hatamian, 2011).

3. Constructed Conversations

Groups in Civil Society construct their identities, that is, the meanings that they are fighting for in society (i.e. issues, expectations and opportunities). This construction is the outcome of difficult negotiations and communications among citizens. Identities emerge from the way in which citizens relate to each other in their moment-to-moment communications. Citizenship is observed as a stable construction-property that emerges from those interactions (Mendiwelso-Bendek, 2002). Citizens are producing the contexts they belong to at the same time of being constituted by these contexts (Espejo, 2000). Take Part facilitates the recognition of possibilities and diversity through facilitated constructed conversations. These conversations are designed to help the participants in civil society to be systemic observers of their own internal processes constructing issues and also from the outside as external observers. The systemic observer is inside and outside the action. From this perspective they simultaneously observe themselves as actors and observers in a circular causality (von Foerster, 1982).

Constructed conversations in civil society need structures that at the same time of harnessing the interactions of groups operating under non-coercive rules and, as yet, undefined purposes, enable inclusion of all people and openness of expression for all viewpoints. These should be facilitated conversations, which steer groups towards shared issues maintaining their course through on-going feedback (Beer, 1994).

4. Conclusion

At a more global level the state is responsible for enabling effective processes of self-organisation in civil society. As civil society becomes stronger its demands on the state and the economy will increase, and in particular the state will have to strengthen its organisation to respond. This is likely to produce a relationship where the circularity will increase mutual demands and opportunities. The self-organisation of civil society needs of a social context that respects justice and freedom. Social justice is a key element of civil society and involves not only self-determination but also self-development. Self-development means being able actively to engage in the world and grow, which requires state intervention its own activities and those of the economy and civil society.

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Her work in the Active Learning for Active Citizenship Programme led to a successful research proposal to the Economic and Social Research Council in 2008. 'Taking Part?' The ESRC Research Cluster for Community Engagement. 'Taking Part?' is one of the three research clusters supporting the Third Sector Research Centre (TSRC) led by the University of Birmingham. This Cluster is a partnership of the University of Lincoln, Goldsmiths University of London and Manchester Metropolitan University. Its research aim is strengthening civil society, promoting active citizenship, social justice and community empowerment.

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An Organizational Cybernetics Approach to University Urban Planning

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Abstract: *Managing a public university can be considered a highly complex task. The variety of factors to be taken into account demands that University managers have access to decision-making tools commensurate with the complexity, which they must face. In this work we will show how the top management of the University A Coruña (UDC) (Galicia, Spain) used a systemic conceptual framework based on Organizational Cybernetics as a guide on which to base their decisions related to the design and use of university spaces, helping them assume that the design of university-space policy must take into account simultaneously multiple dimensions and scales (recursion levels). Taking into consideration the wide urban region in which the UDC has a socio-economic impact, the use of this framework, in particular a Recursion Levels-Key Factors Matrix, allowed the identification of pertinent recursion levels and the clarification pertaining to each in light of the university´s purposes. This, together with the recognition of the main factors to be taken into consideration at each level, helped to design the various intervention actions. We describe various examples of actions carried out at different recursion levels and their motivations.*

This work ends with some reflections about the impact that this intervention had within the university (i.e. the design of organizational structures such as the Architecture and Urban Planning Service) and also in its environment. The use of this systemic/cybernetic framework provides a structuring guide within the university to the design and functioning of organizations related to urban planning and architectural issues.

Keywords: organizational cybernetics; recursion levels-key factors matrix; University Urban Planning

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Designing Effective Organizational Conversations

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Abstract: *Communication provides the link between people and information. Effective communication in organizations increases productivity, decreases employee turnover and improves the working atmosphere. In the world of companies, institutions and communities, listening goes much further than speaking and is undoubtedly the most important component of effective communication. Listening extends far beyond hearing and understanding the words of a particular language. Communication distributes information, but conversations create understanding. Leaders speak of their desire to develop listening improvement programs and hold large-scale public conversations in their companies or communities. But they won't succeed in their intention if the methods employed fail to satisfy participants, or if no authentic conversation occurs. This paper presents an example of the creation of shared languages using conversation networks as a viable approach to involving large numbers of people in a conversational exchange. The method involves the Word Café approach (Brown, 1995), which it reinterprets as a method that leaders of organizations or social systems could employ to achieve a balance between design conversation, social change and self-organization.*

Keywords: conversation; method; design conversation; organization; café CNC

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Introduction Broadly, the concept of effectiveness may be said to refer to the degree to which an organization is successful in reaching its goals. Clear goals make it easier to concentrate resources and strategies on achieving the objectives that an organization or social system may have. For example, we can take any organization and see it as a set of permanent interactions of relationships between its different stakeholder groups (owners, employees, clients, management, unions, providers, creditors, and the community). In this interaction it is clear that different groups have different interests. For example, while the owner is interested in financial returns, management focuses on efficiency and effectiveness, and employees on a fair wage, decent working conditions and job satisfaction. That is: each group has its own point of view and evaluates its levels of satisfaction using different indicators to assess performance and organizational effectiveness. A similar situation occurs in social systems whose many constituent groups also have varied interests.

1. The role of Conversation in Organizations

But, if each group has different interests at what point does the organization emerge as an entity? According to Espejo (2000), this happens when the recurrent interactions of a group of people create, regulate and produce collective meanings. Collective meaning is constituted through language; and through language the individual criteria of the different groups are woven, observed and interpreted (Bermeo, 2010). “Therefore, there is an organization when meanings and moment-to-moment interactions produce each other” (Espejo, 2002, p. 517). The articulations of different points of view emerge and operate through language, by way of conversations. However, these conversations are not linear chains as in the model developed by Claude Shannon. Shannon’s model does not involve those who are communicating saying novel things to each other (i.e. this is not a conversation). According to Dubberly and Pangano (2009), “we need the capacity for new messages to be generated and the resultant understanding to be confirmed or denied. We call such interaction “conversation.” (p. 2). In this way communication distributes information, but, conversations create understanding. However, not all individuals, organizations or social systems have strong communication backgrounds. They are therefore likely to require a good deal of investment in designing new conversation methods – which should not be rigid or imposed – if they are to ensure effective listening and speaking. So, how can leaders maintain effective communication that is based on the diversity of opinions held by others and where conversation, involving the transfer of information and the encouragement of understanding, can be seen as a tool that people may use to persuade others and to accomplish shared goals and objectives.

2. About Design Conversation

Over the last three decades design conversation has been defined in different ways (Banathy, 2004; Jenlink and Carr, 1996). Fundamentally, it involves broad, shared, dialogue. It should be noted that it involves moving beyond general conversation to the creation of more inclusive dialogue. Banathy maintains that social systems design "is a process that carries a stream of shared meaning by a free flow of discourses among the stakeholders who seek to create a new system" (2004, p. 213). He distinguishes between two kinds of dialogue: the strategic and the generative. Generative dialogue leads to common ground and the collective consciousness within community design. Strategic dialogue concentrates on specific tasks and is applied to the search for specific solutions rooted in the original research decisions. According to Jenlink (2001), “design conversation is not a *singular type* or *form* of *social discourse, but rather a dynamic system* comprised of *different forms* of *discourse,* each with its own purpose and *each* with a particular *purpose* and *mediational importance.*” (p. 352). For Hugh Dubberly and Paul Pangaro (2009) regard conversation and interaction as a series of processes that enable participants to learn, coordinate and collaborate.

Additional factors to take into account when designing conversations are the emotionality of the participants and the generation of shared languages. “We human beings exist as emotional animals that live in languaging. That we exist as emotional animals means that, as all living beings do, we flow in our living, changing our relational behaviors according to the relational nature of the circumstance in which we find ourselves at any moment.” On this, Espejo (2002) maintains that our experience in collectives is that the coordination of actions is made difficult by a lack of shared languages as well as by the volatility of our moods. These difficulties reduce the scope for self-organization. In such conditions structural design and restricted languages may play fundamental roles in speeding up the production of structural couplings among the members of the collective (Maturana & Varela, 1987). The inclusion of different characteristics of design conversation is achieved by generating conversation networks. According to Bermeo (2010) the generation of conversation networks in an organization permits a dialogue to be established that focuses on the interests and preoccupations of all those who make it up (that is, the networks distribute information). In other words, the establishment of conversation networks provides insights into the opinions of all the members of the organization (it creates understanding by generating shared languages) within a conversation space based on the diversity of others’ opinions. "Conversations" can go further if leaders allow them to become central to how organizations work, rather than leaving them on the margins. While it is not the only technique, an example of the ways in which shared languages can be generated is provided by the Word Café method, Open Space, Theory U.

2.1. About The World Café

The World Café movement employs a methodology that involves the creation of informal conversational and social learning networks that favor the communication and exchange of experiences between large groups of people on issues of importance to an organization. By establishing these connections using informal communication mechanisms, new patterns of behavior are created and decisions made that, in some way, create a new reality. The World Café method involves rounds of conversation, after each of which participants change tables, creating a dense network of connections in a short period of time. The method favors the rapid creation of a dense web of connections, the development of collective intelligence and the cross-pollination of ideas during the different conversation circles - which become deeper and more involved as the process advances. The method is participatory and ensures that the focus of the conversations evolves, passing from the individual to the collective. The basic idea is that round table groups of four or five people, each with its own host, discuss a question or set of questions that structure the discussion. Participants change tables after every round, each member of the group moving to a different new table, enabling them to interact with the largest number of people possible. The last stage involves the harvesting or gathering of the ideas that have emerged, and the definition of conclusions.

When designing the conversation, it is very important to consider its potential course and to establish its limits. The World Café method is of little use when the leader of the organization or social system has already decided on the outcome or intends to communicate information unilaterally. The important thing is that the method should generate conversations that act as connectors between people and ideas.

3. Molding Leaders through Conversations

Effectiveness can be understood as the degree to which an organization meets its goals. Conversation is an important part of effective leadership. The social objective that unites individuals or unifies a social system is not a business or a product but a shared value or vision. The different interest groups that constitute organizations or social systems are not alien to this idea of shared values. Employee or citizen engagement is driven by meaning and purpose; policy execution requires the alignment of action and all participants should be involved in the conversation. Leaders need to open up the topics of discussion and support them by providing the opportunity for continuous and ongoing conversations to be established. In all cases, if effective organizations are to emerge they require that innovatory, top-down, structures and processes are developed alongside complex, self-organizing bottom-up practices.

4. Conclusions

Some preliminary ideas about the implications of designing an effective conversation in an organization might include: If the organization or social system hopes to generate change, the starting point should involve changing the ways in which an organization converses with itself, followed by creating a leadership model that involves the presentation and not the imposition of ideas. People and communities evolve as a result of the conversation. Collaborating with others towards a shared purpose is advantageous because it allows everyone to identify with a common set of goals. A shared purpose creates alignments between the people and groups in an organization, without negative cost implications. The creation of conversation unmasks the factors that determine the personality of an organization. In most cases organizations are structured in ways that ensure there is no conversation. Instruments like the Word Café are intended to ensure the existence of multiple conversations.

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The World Café at http://www.theworldcafe.com/

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I completed my degree in Engineering in 1995 at the University Nacional de Colombia. In 2001 I finished my Master degree in engineering at the Universidad de Los Andes and the Following year I Began my PhD studies. In 2005 I was a visiting student at Oxford University at the Clarendon Institute and in 2006 I Became a PhD Visiting Researcher at Universität St. Gallen in Switzerland. In 2010 I received my degree as Doctor of Engineering (EngD) which focused in social cybernetics, management cybernetics in practice and the social systems. From 2007 to the present day I have been lecturer in the Department of Industrial Engineering at the University of the Andes, where, I teach courses ranging from the Cybernetics of Cybernetics, Systems Thinking in the Organizations and Organizational Diagnosis and Design. Currently I am Managing Director of Instituto de la Conversación.

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Communications, Interactions and the Re-structuring of the English National Health Service

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Abstract: *The National Health Service in England is entangled in a massive and highly controversial restructuring. One of the authors has an in-depth knowledge of this Service and the other is an expert in organizational design. Together they have gone through the key principles underpinning the proposed restructuring. Our purpose with this contribution is highlighting what we consider key systemic and cybernetic aspects of the proposed changes. From a methodological perspective there are different possible definitions of the system-in-focus, and from the management of complexity perspective the study of the restructuring highlights relevant communication and interaction issues necessary to consider in designing this large organization. This paper highlights these two aspects.*

Keywords: National Health Service in England; communications; interactions; organizational design; self-organization; self-regulation

1. An Overview

In each decade during the past thirty years or so the UK government of the time has engaged in a major reorganization of the National Health Service (NHS). There are two major principles that have remained since the inception of the NHS - firstly that it should be free at the point of delivery, and secondly that it should be universally and equably available to all who are entitled to receive its benefits.

Underlying the perceived need for re-organization are three major factors, the rapid advance of medical technology and the possibilities for therapeutic intervention, the very much raised expectations of the populations about what they demand of the NHS, and the ever increasing costs of healthcare as a proportion of the GDP.

The direction in successive reorganizations has been to construct effective structures for the distribution of scarce resources through the NHS. It is now accepted that there should be a separation of commissioners (purchasers) of healthcare and its providers. The previous Labor government initiated the move towards creating quasi-autonomous Foundation Trust Hospitals that could compete with each other, and to a limited extent compete with the private sector in the provision of hospital services. Foundation Trust Hospitals are replacing the NHS Hospital Trusts controlled by Strategic Health Authorities, which are disappearing in the reforms.

The present Conservative government is attempting to move towards the next step which is to disperse and localize commissioning by devolving decision making to clinical commissioning groups (CCGs) based upon consortia of locally based general practitioners (GPs), and also to facilitate the involvement of the private sector in both provision, and in commissioning support. Additionally it is attempting to give to local authorities throughout the country the responsibility for public health in addition to adult social care, which is already their responsibility.

Alongside this move towards decentralization of both commissioning and provision there are two opposing tendencies. One is the need for the government to ensure that taxpayers' money is being effectively and efficiently spent. This requires the establishing of a central NHS Commissioning Board to establish annually an operating framework to which CCGs will be bound to adhere, and two regulatory organizations, the Care Quality Commission to set and inspect quality standards, and Monitor to ensure due diligence and the financial viability of provider organizations, and also to recommend the pricing/tariff structure within which commissioning will occur. In addition NICE (the National Institute for Health and Clinical Excellence) will "license" drugs, therapies and other interventions that can be permitted within the NHS.

The other issue relates to combined arguments about both the fragmentation and privatization of parts of the NHS that could lead to differential and inequitable access to services. Much of this debate has been cast in terms of the privatization of the NHS.

This paper is a first attempt towards a systemic review of the proposed restructuring. It starts by defining a system-in-focus for this review and then it offers a model to study the restructuring's implied management of complexity. The argument is that agreement about these two aspects offers a good platform for discussing the strengths and weaknesses of the proposed changes.

2. The System-in Focus

Quite naturally the restructuring can be seen from different viewpoints. Systemically, the NHS, with its wide range of resources, is our organizational system. From the perspective of its unfolding of complexity (Espejo, 1989) the restructuring espouses a service with only two structural levels; the national and local. However, it is apparent that this is a gross over simplification; there are hospitals of national, regional and local significance and there are regions of hugely differing complexities between the national and local levels. London in its own right has several layers of complexity.

A number of questions can be asked. Which are the organizational systems within the NHS? Is it not that large national and specialized hospitals need to be considered as embedded organizational systems in their own right? Is it not that a National Commissioning Board cannot possibly allocate directly resources to CCGs in remote regions of the country? Is it not that it needs the amplification of regional commissioning boards, with accountability and discretion to negotiate the allocation of resources at the local level? These are questions that must be considered by those driving the reforms, and most probably they have, but their answers let alone their systemic implications have not been spelled out. The unfolding of complexity of the NHS is an important issue to study and make decisions about political accountability and central-local relationships. We take the government's viewpoint of considering the CCGs as the corner stone of the NHS restructuring, and more specifically we see a GP led Clinical Commissioning Group (CCG) as the system in focus for our inquiries. The restructuring gives to CCGs control of the necessary resources to commission health services for their local population. Each CCG can be seen as a viable system striving to deliver high quality community health services as it co-evolves with people in the community and also with the wide range of providers, themselves striving for their viability. Our reflections are driven by this viewpoint and the communication and complexity management strategies implied by these reforms (Beer, 1972; 1979; 1985; Espejo & Reyes, 2011).

Communication between a CCG and the Community

Health services anywhere are extraordinarily complex and the challenge to achieve good performance is daunting. In tandem with people's increased appreciation of health issues it is natural that pressures on providers increase. In the proposed restructuring GPs assess individual needs and commission the necessary services from providers. Achieving high performance in this relationship is at the core of their complexity management.

Improving the role of GPs as drivers of health services through a wide range of providers is indeed a necessary concern of the restructuring. The outcomes of the interactions between GPs and patients involve much more than these interactions; they need to account for full-fledged communications, which are shaped by the contributions, among others, of a variety of other health and social care professionals, a web of service providers, multiple public health services and politicians. Beyond interactions, most important to these communications, are self-regulating and self-organizing processes, which absorb large chunks of relevant situational complexity (Espejo and Reyes, Chapter 4). These processes are governed, among other aspects, by culture, technology, politics and individual and organizational behaviors including competitive markets. These are soft variables that enable and/or block quality interactions to different degrees. By and large we are aware of these variables but a good understanding, and as far as possible a good design of communications between people and GPs can make the difference between a successful and unsuccessful NHS restructuring, that is, between a high performance restructuring, and a fragmented, privilege driven health service. In this short paper we only attempt a brief description of this web of communications; much more work is necessary to unpack its complexity.

Interactions between community people and GPs are asymmetrical. There is a huge imbalance between the large variety of health issues affecting people and the attention that GPs can give to these issues. Each GP may need dealing with thousands of patients, each with their particular health concerns. On the one hand GPs have, in general, more knowledge about these issues than individuals. The challenge is designing GP-patient interactions, and as far as possible communications, in a way that individual needs are met by high quality responses. For instance, public health services are hugely important to reduce the likelihood that people will need personal attention. In that sense they may attenuate demand through people's self-regulation; people take care of their own health. The residual number of cases that need medical attention may require that GPs commission health services from providers. GPs' productivity relate to the balance between these two strategies; in simple terms, the more public health services reduce demand for providers' procedures the better is likely to be GP's productivity.

A consortium of GPs' surgeries constitutes a Clinical Commissioning Group (CCG), hence structurally CCGs are constituted by autonomous surgeries. In general CCGs will have tens of surgeries, which may have different numbers of GPs and healthcare professionals. For instance in Lincolnshire, one of the English counties, 5 CCGs are envisaged for the whole County, each responsible for one to two hundred thousand people. In practice primary care trusts (PCTs) will be replaced by a similar number of CCGs, but now GPs will control their own budgets for commissioning purposes. The commissioning capabilities of CCGs, is unclear, and most likely they will need people today working for PCTs and also private consultancy firms with healthcare knowledge (e.g. Capita, Price Waterhouse...). The key change is the GPs' execution of budgets rather than PCT bureaucrats' taking centralized responsibility. However, a number of organizational factors will affect their performance, such as the functional capabilities of surgeries' and CCGs.

Surgeries' organization within each CCG may vary significantly, some will be highly organized others less so; this is likely to trigger self-organizing processes and therefore GPs performance within CCGs. From a structural perspective the organization of these surgeries is likely to vary widely, from highly sophisticated surgeries, running a significant number of in-house services, to small surgeries relying on external local services to offer similar functions. We may expect a significant degree of self-organization within each CCG; small surgeries may develop alliances with the larger ones, larger surgeries may develop in-house clinical services at the expense of services currently provided by hospitals or private providers. Local structural adjustments will take place in one form or another.

Regarding the provision of services the key players are hospitals; they are being restructured from local trust hospitals to autonomous foundation hospitals. An important aspect is that the NHS Commissioning Board, supported by regional commissioning boards, will recommend tariffs for all procedures. This arrangement will restrict competition. To improve productivity, and therefore the hospitals' competitive position, the organization and cost structures of foundation hospitals will be crucial. Under these pressures agreements with other public and private providers will be necessary. This transformation will allow hospitals to develop alliances with other hospitals and private providers; we may expect a significant degree of self-regulation and self-organization as they drive improvements in their productivity. Success will require enabling cost-effective and fair processes of self-organization as well as a culture of honest self-regulation. These can be seen as major concerns for the future of the restructuring.

Similarly public and social health services, whether to reduce avoidable demand for healthcare or to support quality of life, have important implications for the interactions between GPs and people in the community. The restructuring makes local authorities responsible and accountable for public and social services budgets within the context of Public Health England. The evolving communications between CCGs and local authorities will influence the productivity and performance of public health and with that the pressures on the GP-patients interactions.

3. Coda

What are the risks for different stakeholders implied by the restructuring? How is the reform protecting the necessary cohesion of a National Health Service? Will the restructuring lead to unbalanced services between communities? Will the more articulated and skilled in society unbalance the distribution of resources in their favor? How is the restructuring dealing with these questions?

From an internal view of the NHS, what are the main stabilizers to maintain the balanced development of health services across the country? Are the resource allocation formulae of the Commissioning Board flexible enough to cope with regional cultural variability? What's being learned from pilot CCGs? To what extent these pilots have been driven by local self-organization or have been the result of decision and rules coming from the NHS Commissioning Board (e.g. tariffs)? How is the natural mix of sophisticated and less sophisticated surgeries affecting CCG, surgeries and GPs performance?

As already said, a major responsibility of GPs will be commissioning services. For this purpose they will need communicational competences that possibly are beyond their previous experience. They will need to assess the technical competence of providers as well as their legitimacy and authenticity (Habermas, 1979, Espejo, 2007). Providers can be public or private hospitals or providers of any other health service; this variety poses significant communicational challenges. We may expect, as an outcome of self-organizing and self-regulating processes, that all kinds of agreements will emerge between public and private hospitals and services. How is it possible to avoid unfair competition and improve cooperation between these services? How is it possible to achieve a healthy cross fertilization of public and private innovation and research and development, avoiding the private use of public resources in their own benefit, undermining the provision of public services? What are necessary regulatory mechanisms to harness self-organization in desirable directions?

To a large degree we expect that these questions are already being investigated. Our concern is answering them, and other related questions, considering the systemic context of interactions between GPs and patients. We argue that these answers should help improving the overall performance of healthcare in the country.

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Raul Espejo is an international expert in organizational cybernetics. His most recent co-authored book "Organizational Systems: Managing Complexity with the Viable System Model", was published by Springer early in 2011. He is co-author of two other books and co-editor of three and has published over a 100 articles in journals and books. In the early 70s, during the Allende's government in Chile, he was Operations Director of the CYBERSYN project under the scientific direction of Stafford Beer. Since then until 2003, he worked at the Manchester Business School in the UK, the International Institute for Applied Systems Analysis (IIASA) in Laxenburg, Austria and the universities of Aston and Lincoln in the UK. In 1985 he set up in the Science Park of Aston University Syncho Research (www.syncho.com), from where he has done research in a wide range of institutions worldwide with a focus on social transformation, organisational learning and democratic processes. Currently he is Director-General of the World Organization of Systems and Cybernetics and Director of Syncho Research.

David Hooper

David Hooper has been Chair of North Middlesex University Hospital NHS Trust (NMUH) since March 2007. Prior to that he was Chair of Basildon and Thurrock University Hospitals from 1996-2007. In 2004 he led the trust through to become one of the first group of ten Foundation Trusts. With the chief executive he is currently steering NMUH to achieve FT status amidst the changes described in this paper.

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Symposium T. T. Enabling Organizations for Thrivability: New Perspectives on Form, Structure and Process in favor of Human and Societal

Chairs: Stefan Blachfellner, B original, Business and Communication Design, Salzburg, Austria, Violeta Bulc, Vibacom House of Business Solutions, Ljubljana, Slovenia, Thomas Fundneider, tf consulting, Vienna, Austria, Alexander László, Syntony Quest, Sebastopol, CA, USA

One day facilitated workshop, dialogue, conversation, sharing, co-inspiration, and co-creation

This symposium invited the participation of creative transdisciplinary thinkers and practitioners from all fields of inquiry and practice. Thinkers, designers, practitioners and researchers with experience in the sciences of life, energy, matter, cognition, cosmology as well as the social sciences and the humanities were welcome.

The reunion offered a unique opportunity to come together and share a variety of viewpoints on a broad range of issues relating to emergent patterns, processes and relationships of life and living systems. Our wish was to provide a playspace where we could jointly curate the emergence of more sustainable and even thrivable systems.

By exploring cutting edge inquiry across a variety of types of non-linear complex adaptive systems, we hope to gain insight into processes of self-organization and emergence that relate to life and experience. By exploring learning in the areas of living systems, natural systems, social systems and technological systems, we hope to emerge patterns of organization that may contribute to new ways of being and doing in the context of an evolving eco-civilization.

The objective of this symposium is to contribute to an evolutionary narrative of the next phase of human civlization in a time of global personal awakening. The intention is to cultivate this narrative through the association of the creative efforts of those participating in the symposium as well as with those engaged in similar efforts in other venues.

This symposium was intended to function as a window from the inside-out of the systems sciences. Participants

- were invited from the **academic areas** of natural, biological, social, and technological systems to enrich these knowledge realms.
- were invited from the **practical areas** of design, creative industries, integral development, management, experiential psycho-therapy, and applied social anthropology to inform and be-informed by each other’s perspectives.

Alexander Laszlo: *Emerging the Global Eco-Civilization – Pattern, Process and Perception in Service of the Possible*

Allenna Leonard: *Building Coalitions for Sustainable Systems*

Borut Potocnik: *Thrivability Beyond Innovation*

Daniela Freudenthaler: *Contextual Thinking and Acting in Design*

Frithjof Bergmann: *The Now Possible Radical Ascent*

Georg Weichhart: *Constructing a new Role for Teachers – An Empirical Study Identifying Teaching Needs and Required Support for Dalton-Plan Pedagogics*

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Emerging the Global Eco-Civilization

Pattern, Process and Perception in Service of the Possible

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Abstract: *As our species finally breaches the carrying capacity of the planet we call home, we are faced with the perennial challenge: evolve or die. But now the challenge is both global and immediate. We have explored and exhausted the identity of Homo Sapiens sapiens. We must move on, evolve beyond the strategically wise, the rationally refined, the intellectually erudite and the technologically talented. Our patterns of being and becoming now need to match the patterns and processes of ecosystemic meta-stability found in nature and the cosmos at large. But for this, we must abandon our ego-centric conceptions of self. We must no longer look out at the world through the eyes of individual interests. And above all, we must be ready to repudiate our gladiatorial existence and learn what it means to be a communal being. To commune with ourselves, with each other, with nature, with past and future possibilities. This is no mere poetic flight of fancy. It is the survival imperative or our times. Beyond re-conceptualizing ourselves in this way, the true challenge lies in post-conceptualizing the relational states of emergence that continually manifest the patterns of being and becoming that create conditions conducive to life. We cannot do this alone. Homo Sapiens sapiens is a species bound for extinction. This is cause for celebration. We must become Homo Sapiens cosmicus – capable of manifesting both our mundane individuality and our sacred connectivity as part and whole at one and the same time. What are the forms of perception that propitiate such engagement? Can systems thinking and holistic being provide platforms upon which to curate the emergence of new species identity? What are the patterns and processes currently alive in our world that intimate the possibility of co-creating a global eco-civilization? And how, and in what ways, must consciousness shift to propitiate such an evolutionary paradigm shift? This paper will explore these questions in the context of Symposium T, "Enabling organizations for thrivability: New perspectives on form, structure, and process in favor of human and societal prosperity."*

Keywords: *holistic being; transcendent consciousness; curated emergence; systemic perception; global eco-civilization; post-conceptual knowing; evolutionary innovation*

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Building Coalitions for Sustainable Systems

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Abstract: *A growing chorus of voices since at least the middle of the twentieth century has been pointing out the risks to our common environment of the impact of human activities and the necessity of taking action to preserve, protect and restore the environment on which all life depends. Although there has been progress in both legislation and practice, the pressures of population growth and exploitive development have been increasing the stress on and damage to our environment and the health and well-being of us all.*

Obstacles to corrective action arise from those who are unwilling to make changes through habit or because they value economic gain to the exclusion of other factors. That this is a short-sighted position is obvious to anyone who has considered the great potential of new and greener products and services.

What is needed is to build coalitions between people who, in a variety of ways, depend upon and appreciate our shared natural environment. This coalition needs to begin with First Nations, where there are indigenous populations. The survival of their persons and their way of life is most directly dependent on nature and they have a set of non-economic values that provide a solid grounding for deep understanding. People who make their living from the land and the sea, farming and fishing, are also on the front lines as their way of life is also under immediate threat. To these immediately affected groups we must add innovators and providers of new products and services, environmental activists, universities, governments and NGO's who wish to move forward.

The way forward will require increasing levels of communication both face-to-face interactions around group processes and models and crowd-sourced communications that draw from disparate people in disparate locations. It is important that these communications include both practical and scientific research and application and social strategies to engage the emotions and inspire insight and commitment. Some of these come from the cybernetics and systems communities and others from grass-roots leadership consciousness raising and training developed for citizens groups.

Keywords: sustainability; coalition; viable system model; organizational cybernetics and systems

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Allenna Leonard consults in organizational cybernetics as the principal of The Complementary Set in Toronto and, in particular, in the Viable System Model and work of Stafford Beer. She was a member of the founding board of Team Syntegrity International and is now pleased to serve as one of its board members and as a director of the Cwarel Isaf Institute both of which are part of the Malik Management Centre in Switzerland. She continues as an organizer and facilitator of the Team Syntegrity process. In recent years, her concern with viability has been focused on issues of sustainability in the natural and social environments.

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Thrivability Beyond Innovation

Identifying Competitive Advantage and the New Corporate Paradigm in the Post-Innovation Era

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Abstract: *Development through the decades reveals different fields making up the competition race: Productivity, Quality, Diversification, Flexibility and Innovation. The actual field is Innovation, upgrade is in the perspective. History proves that a new field appears when the predecessor field becomes treated as the default and a new goal becomes relevant. As the whole set of elements depending on competitiveness and creating corporate and entrepreneurial life and style can be called a paradigm, the paradigm-change in future can be predicted with the help of knowledge of past changes.*

Keywords: competitive advantage; fields of competitiveness; future paradigm; paradigm factors; paradigm upgrade; productivity; quality; diversity; flexibility; innovation; efficiency; management consulting

Acknowledgement: I am extremely grateful to the late Dr. Janez Dekleva, my mentor, teaching us 25 years ago operations research and production systems, stressing repeatedly that despite the topic he was teaching we should direct our children into the entertainment industry, which would probably come to be the leading industry in our part of the world 30 years later. That gave me dialectical insight from the beginning of my career. This research work would not have been possible without my over 170 clients teaching me the lesson of constant change and perpetual paradigm change. Finally I am grateful to my children. Despite the fact that attitudes and love remain constant across generations, their social inputs and topics of interest advocate unavoidable generational change.

The innovation trend or paradigm has continued for at least a decade now. The most innovative are leading competitors within particular sectors. Innovation is the actual competitive advantage and runs the actual paradigm. In view of history and the very real financial crisis some change of the competitive advantage or the paradigm might soon be expected.

The discussion may reveal some indications on the future paradigm upgrade.

1. History

Observing the development of competitive advantage through the second half of the 20th century and the first ten years of the 21st reveals five different consecutive fields of competition battle. As the new fields were introduced, all previous fields became obligatory defaults in later stages.

Particular fields of competitive advantage has meant, in the wider sense, a new paradigm of the time. It represented a particular market approach, methodologies, organizational properties, process perspective, corporate culture and values. It came to management first and came to include each and every worker during development time.

Every field of competitive advantage or a paradigm reaches its end – when the methodologies somehow saturated the industry and some new goal or obstacle came into view. Taking the obstacle into consideration automatically meant opportunity for new competitive advantage and consequently the appearance of a new field of competitiveness and, in wider sense, a new paradigm.

Understanding the reasons behind the fading of competitive fields in history and the successful identification of upcoming obstacles can point us early on in the direction of the new field of competitiveness and toward a new paradigm.

1.1. Fields of competitiveness

Productivity can be considered the first paradigm in the observed timeline. It was introduced after World War II and was fully engaged in the 1960s. It was a consequence of the technological, logistic and media capacities of the time. Mass production had to be faster and cheaper. A lot of productivity enhancement methodologies were developed and successfully implemented. Hard work was a value. Rises in productivity spoiled the quality of products.

Quality was therefore the logical consequential step in the effort to enhance the competitive advantage. Circles of quality, quality standards, different approaches providing sustainable and thriving quality were introduced and implemented. Systems of responsibility changed. Obtaining and maintaining a quality standard expressed as several pages of rules became a competitive advantage. Good work was a value. High productivity and quality prevented diversification of the product, which was difficult to achieve due to fixed high productivity setups and quality guidelines.

Diversification was the next logical paradigm. A wider product range became a competitive advantage. Products and services appeared in different colors, variations, etc. Services could be ordered in several variations too. High-end technology became an important competition factor. Learning was a value. Increasing the range of products complicated the supply chain and inventory systems. Inventories rose and delivery times stretched longer. The problem of inventories and delivery times initiated a search for solutions in the direction of new competitive advantage that ensured shorter delivery times and stock optimization.

Flexibility was the answer to those demands. Fast response and lean process were the competitive advantage. Flexible production systems as cellular production structures and lean systems were introduced. Similar processes were introduced to non-production industries. Flexibilization also introduced less hierarchy and more flexibility among workplaces, flexible organization charts, project-oriented processes and greater individual responsibility. Corporate culture and values changed again. Skills were a value.

The next competitive advantage could only be faster development of new products and services, which could be interesting for the market or more efficient processing. The answer at this stage is **Innovation**.

2. Present moment

Innovation is the general paradigm of the present moment. From technology and processing issues early on, innovation today is spread through organizational, cultural, cognitive and other channels. Lots of methodologies are already developed to maintain sustainable innovation and to grow it. Creativity is a value. Beside innovation itself all competitive advantage fields from the past are included into the competition race.

3. The discussion

The discussion should consider historical developments and some vertical observations along the timeline.

In the past, some industry sectors showed pioneering in a particular or several fields of competitiveness, e.g. the automotive industry, garments or pharmaceuticals. Such cases provided other sectors good practice examples in advancing. Therefore the fact that all industry sectors didn't follow developments at the same rate has to be taken into consideration. The timeline is not equal for all sectors. There is a particular gap between the leaders and the more conservative sectors, e.g. public sectors fulfilling other missions than the market race.

During all of the process(es) a lot of integration among business partners took place. At the beginning of the observed timeline companies were not connected, with interaction and exchange limited to buying and selling to each other. Quality and later phases required more intensive and deeper vertical integration of supply chains. In the later phases there also emerged the need for some horizontal integration. Those directions might also be an indicator of the new change.

IT and ICT are crucial infrastructure factors. Basic computing in the Productivity era, document exchange in the Quality era, BP support and robots, ERP's, etc. later and social networks is the latest challenge whose potential remains unexploited.

Faster steps were made in the past after various crises. At the present moment this condition will soon be met.

4. Conclusion

The discussion will work to reveal the next competitiveness field and the future paradigm upgrade based on the identification of factors and triggers of the present situation in comparison to developments in the past.

References

The topic is developed on the basis of my own management consulting experience and on the exchange of views with other consultants and management consulting companies.

Author's own references are not listed.

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After gaining a diploma in Industrial Engineering from the Faculty of Mechanical Engineering and the Faculty of Economics in Ljubljana, Borut has been employed by the Faculty of Mechanical Engineering as a research assistant in Production Management. From 1989 he worked as a management consultant: first for Produktivnost Management Consulting in Ljubljana, and from 1994 for his own management consulting company. He is active largely in Slovenia ad the surrounding area. He first developed competence in Process Optimization, and later extended this to Internal Development Strategies and Competitive Advantages based on Product Definition and Performance Efficiency, with more than 170 projects in total. He now works as a management consultant and as an interim manager for client companies.

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Contextual Thinking and Acting in Design

The Case of Emerging Markets

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Abstract: *In recent years many multinational companies headed for market opportunities in emerging markets. This poses a challenge in several fields. Developing and designing for emerging markets requires contextual knowledge. In order to ensure that design concepts meet customer expectations the design process has to be accompanied by contextual thinking and acting. Design teams have to find ways to integrate contextual information into their design practice. This work aims at developing a framework for contextual thinking and acting from a designer's perspective. Although in business pratice design for emerging markets is a highly relevant topic – from an academic point of view it is rather underinvestigated. The contribution to progress in research is based on formulating a contextual design approach in an emerging markets-specific framework and furthermore defining which aspects are especially related to the design process. A guideline is offered to companies that face the challenge of designing products for emerging markets.*

Keywords: contextual design; emerging markets; design-related contextual information; research methods; information processing; design process

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Daniela Freudenthaler is product and business developer at LIMAK Austrian Business School and responsible for the overall field of „Creativity and Innovation". In her position as development expert she teaches in executive programs and supports industrial companies in developing innovation strategies and cultures. Prior to this role Freudenthaler worked as a research assistant at the Institute of Marketing, Johannes Kepler University Linz and Copenhagen Business School. In her research she deals with different perspectives on creativity and innovation and is highly interested in interfaces and interdisciplinarity moderating the success of creative solutions. She explores different methods enabling corporate innovation as well as contextual factors influencing creative processes. She lectures in different design, arts and marketing courses, is vice president of the design forum Linz and has co-founded „dcntrl", a network for communication, innovation and strategy.

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The Now Possible Radical Ascent

New Economy, New Work, New Culture

Frithjof Bergmann

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Abstract: *A massive and variegated array of recently discovered new technologies allows the ascent to a radically New Economy, which will no longer manufacture in gigantic factories, but instead in "small rooms." This economy will be local, decentralized, in many respects rural, incomparably more sustainable, and oriented towards the manufacturing of products that serve authentic and genuine human needs. A dramatically new organization of work can be developed on the basis of this New Economy: 10 hours a week will be High-Tech- Self-Providing Work, 10 hours a week will be Job-Work in New Work Enterprises, and 20 hours a week will be Work that one really wants to do. High-Tech-Self-providing comprises a range of productive activities from the raising of food (Permaculture, Vertical Agriculture, fishponds, etc.) to the self-building of the dwellings for one's life, to the self-generation of electricity to the small space manufacturing of appliances and also of a large spectrum of electric means of transportation. Examples of New Work Enterprises are the making and distribution of Eco-cement, the small room manufacturing of Air-conditioners, and the small-room manufacturing of electric Motor Cycles. Work that one really wants to do increases one's strength, gives meaning to one's life, and moves one beyond the passive observing of life into the full and to the hilt real living of it. Nothing less than the transformation into this new organization of work and the attendant generation of a New Culture will solve the global problems of the depletion of our resources, and of the degradation of the nature in which we live. The new start we need requires a New Economy, New Work, and a New Culture.*

Keywords: new work; new culture; community production; economy; technology; self-providing; self-making; permaculture; vertical agriculture; self-building; eco-cement; fabricator; co-operative; self-reliance; micro-factory; decentralize, really wanted; open source; innovation; transition

New Work is a way up to thrivability! New Work is a ladder, up from the Economy, Politics, Society, Culture that we have now up to an Economy, Politics, Society, System of Work and Culture that will be more humane, more intelligent, and yes, more cheerful.

New Work says No to the absolute, dead-certain conviction that there is no alternative to the creation of more businesses, the stimulating of the economy, the making of more jobs. No there is an alternative.

New Work is a commotion, an uprising, a rebellion, but it has in spite of that a very tested, developed idea of where it is going, and crucially not just of the goals it means to achieve, but also and very specifically **HOW**. These delineated steps, will take us upwards to an amazing, not easily imagined state of being, vastly superior to the one in which we flounder and deteriorate now.

1. The "How" of New Work

New Work seeks to build a network of New Work Communities, each complete with fully equipped community centers, housing developments, village-wide infrastructures, community, self-providing activities, and decentralized manufacturing centers. New Work can also organize small groups to band together to employ high tech self-providing techniques while organizing co-operative business ventures based on New Work Technologies. New Work provides the conceptual framework for a comprehensive strategic approach - an integrated, overall framework to organize and coordinate stakeholders, to articulate consistent policies and programs, and to provide coherent rationales to guide decision makers, community leaders, and technology providers in both the public and private sectors.

Employing New Work Technologies creates: Economically independent communities, High-tech infrastructure for community life (housing, food, water, energy), co-operatively owned business ventures, decentralized manufacturing techniques, Entrance into the world-wide markets, Training, education, mentoring, and support for individual and collective pursuits, Access to technology, resources, information, needed for modern life, greater individual and collective autonomy, enhanced quality of life.

To achieve these results New Work:

Establishes connections between projects and technology providers.

Adapts technologies to local conditions.

Mobilizes community leaders and participants.

Ensures technological solutions address community needs and desires.

Develops comprehensive programs.

Coordinates program implementation.

Plans and coordinates installation of technological infrastructure.

Creates training programs in New Work principles and technology uses..

Develops business enterprises.

Opens markets for new products.

2. New Work Technologies

In the last twenty years New Work has identified a multitude of extremely various technologies whose common element is that they all support the possibility of a Base Economy - i.e. the possibility of a very extensive (80%) economic self-reliance. What makes any technology a "New Work" technology is its ability to contribute to an independent, self-providing, and enhanced quality of life for a community. Examples include:

Permaculture gardens and urban farming

Waste water recycling equipment

Fast, low-cost construction techniques

Electrical generation technology

Micro-factories for local production

Compostable toilets

New Work Cafe - Social media/communication and technological access redefining the workspace and work community.

3. The need of New Culture

One egregious mistake is to imagine that work is simply shrinking, that the trouble is no more than this: the frightful illusion that it is only becoming smaller, that there is merely less of it. That stands behind the idea that "economic growth" can cure this, can return us back to health.

Anything merely cosmetic is not enough. We must devise something that will engage the vast majority of humankind, that will bring into action not just a marginal small group which will eat less meat, or will do more recycling, or will use less electricity -- but a plan, a goal, a vision that will make sense and will appeal to the overwhelming majority of people on the planet that abhor and hate and loath the current system.

Therefore, a radically New Economy is just Part I. Other Part must be a new System of Work. A going back to a first starting point. Don't ask: what does everybody want from me, what will be accepted, or what will sell. What will make me liked and successful and promoted? Ask instead: what at bottom and in seriousness and in the solitude of my own life do I really want? That is how the one phrase that attached itself to New Work more than any other, came to be. To find out what people “really, really wanted,” with the much quoted double “really” grew directly out of the idea of this “reversal,” and gave them a chance to make a contribution.

We learnt that work chosen with conviction has three main attributes:

1. It gives strength, it makes vigorous.

2. Many who are forced to perform decimated work because nothing else is available to them, feel that they have no life.

3. Possibly more decisive than all else, work done in earnest, done because it counts gives meaning to one’s life.

Teaching people the high, even the stupendous value of doing work that they want to do, would not close the awful crevasse between the rich and the poor. There would have to be two parallel, related efforts that would be wholly disconnected from each other. First it is self-making, and it is nothing like the old fashioned peasant self-providing. The transition to self-making is much more than any step up to any set of new machines – even up to fabricators. It is best compared to the enormous transformation that moved us from agriculture up to industry. It is a complete, comprehensive forward alteration that includes everything, from the whole wherewithal of material production up to how and where we live, and beyond that to our social and political organization. Second there is the Open Source Movement, there is the movement towards global villages. In the very center of this tumultuously growing hive of innovations is like a massive tree, the internet itself. In retrospect it might become apparent that the most sweeping of all changes that the internet made possible is the development of self-making.

Now we can see the beginnings of the Or. If we use the now available technologies with “intelligence and skill,” then we can with their help create a broad, firm base. The changes that need to happen go very deep. Fortunately today I can account for all this visionary pictures; I have known it real to happen along many actual examples, I will give you not least from my old home country Upper-Austria.

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Frithjof Bergmann has taught Philosophy and Anthropology at Princeton, Berkeley, Stanford and Michigan. In 1982 he established and directed the first Center for New Work in Flint, Michigan, USA. Since then he has worked on many New Work Projects in Europe, the United States, Africa and Asia. His principal publications are: “On Being Free” (“Die Freiheit leben”), “New Work- New Culture” (“Neue Arbeit, Neue Kultur”) and “Neue Arbeit Kompakt”, Freiamt: Arbor.

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Constructing a new Role for Teachers

An Empirical Study Identifying Teaching Needs and Required Support for Dalton-Plan Pedagogics

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Abstract: *Changing education from traditional approaches to progressive forms is challenging for students and teachers a like. Progressive education aims at responsible learners, able to manage their individual learning processes. These approaches also require teachers to change their role in education. Dalton-Plan pedagogy is a progressive education approach. We researched individual views to teaching using Dalton-Plan assignments as an instrument for guiding self-organised learners. The ongoing work is not limited to empirical research, but aims at developing a novel web-based e-learning system supporting teachers to educate, using the Dalton-Plan.*

Keywords: progressive education; Dalton-Plan; e-learning; teacher role; e-learning support

1. Introduction

Current (traditional) education approaches and systems are challenged on multiple dimensions. Society demands that learners should be equipped with problem-solving competences. Additional competences like “creative thinking”, “ability to work in teams”, “performance aware”, “ability to take initiative” are required (Eichelberger et al., 2008). The knowledge-society requires citizens to develop critical thinking and scientific reasoning, with an overwhelming majority of Europeans agreeing that interest in science is essential to Europe's future (High Level Group on Science Education, 2007).

Constructivist didactics (Reich, 2008) and progressive education (Skiera, 2004) share some common principles that support the acquisition of the above competences:

- individual learning strategies and self-organised learning
- knowledge construction in groups
- situated, complex, real problems to solve
- teachers provide a positive learn environment

While there is growing evidence that teaching based on these principles does work,

> *“one of the critical issues is faculty development, helping teachers to become familiar with new approaches to teaching and helping them gain experience actually implementing them ” (Michael, 2006 p. 164).*

The research work at hand, aims at providing an e-Learning environment helping teachers to become familiar with a particular progressive education approach, the Dalton-Plan (Parkhurst, 1924). The Dalton-Plan places emphasis on two instruments, assignments and progress-graphs.

In this paper we present an empirical, qualitative study on the implementation of assignments in general and Dalton-Plan assignments in particular within “e-learning environments”. First a novel qualitative method has been created to combine aspects of qualitative, empirical research and software requirements engineering. The description of the method is followed by a presentation and discussion of the research results.

2. Transdisciplinary Research method

E-learning environments are a means to effectively support principles established by constructivist didactics and progressive education (Auinger, 2005; Eichelberger et al., 2008). In order to design and implement effective e-learning support, the didactics needs to be understood and incorporated in the environment. In a first step it is therefore necessary to understand the basic teaching principles and features used by experienced teachers. Empirical research methods are a means to get this understanding. However, since the overall research aims at building a novel solution to support teachers, only *describing* the views of experts is too limited. A method is needed to pinpoint the core concepts (e.g. features, methods) and their relationships in order to inform the design of the e-learning environment.

Due to limited available existing research in progressive education and e-learning, we identified the need for a research method, which allows to reconstruct knowledge by experts in the field. Exporative expert interviews are a qualitative empirical method that enables getting an initial understanding of a domain (Mayring, 2002). To structure the interviews, we created a guiding list of questions. The taped interviews where expected to contain very rich descriptions and complex interdependencies between concepts. To build an informative abstraction of the interview's content, we have been evaluating methods allowing to model the experts world view, and which are easy to comprehend, so experts are able to validate the models. Graphical modelling methods aim at providing such abstractions. Taking a look at multiple methods we have identified “concept mapping[1]” (Novak & Cañas, 2008) as the best approach to reach this goal.

3. Results

3.1. Dalton-Plan Assignments

To better understand the new role of the teacher and the required support, first a concept map is shown, which shows the expert's view on assignments and the structure and principles included in assignments.

[1] A concept map is composed of two element types: concepts and propositions. A proposition is a concept with a named association and a second concept.

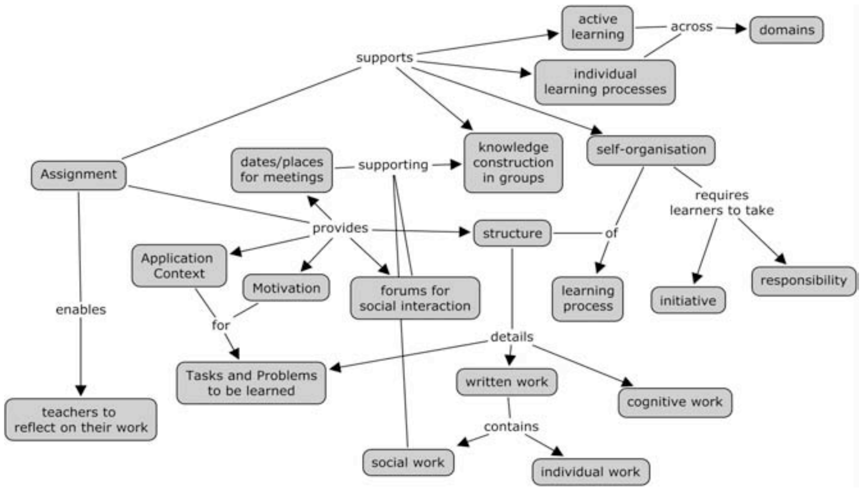

Figure 2: Expert's view on assignments

Assignments in progressive education are used to support active, self-organised learning. Learning is done individually and in groups. Assignments present the structure of the work to be done by learners in advance. However the assignments need to be motivated by real-world application contexts. Learning tasks, which produce documents (ie. written or documented work) need to guide the learning process and keep the result open. Assignments need to make it clear that its the learner's responsibility for the outcome.

To be able to monitor and guide the process, interactions between learners themselves and between learners and the teacher needs to be planed. This includes for example meetings for which learners prepare preliminary results and present it to a group.

3.2. The teachers' new role

The following concept map presents an aggregation of concepts identified by the experts as relevant for the teachers' new role. Teachers are facilitators of the learn process. They monitor the progress of learners and provide impulses to the learning process, rather than giving pre-packaged solutions. To be able to do this, requires some planning and transparency of the envisioned process and expected “milestones”. Assignments therefore need to provide information about the planned activities and social interactions (e.g. meetings). Having a document that makes the overall learning process explicit, allows (at the end of the process) to reflect on it and improve it over time.

However, teachers feel the need for more support. Currently there is no (e-)learning environment for teachers that support them in understanding and learning about the Dalton-Plan. Progressive education also could be better supported by e-learning environments e.g. by allowing teachers to integrate motivational videos in the assignments.

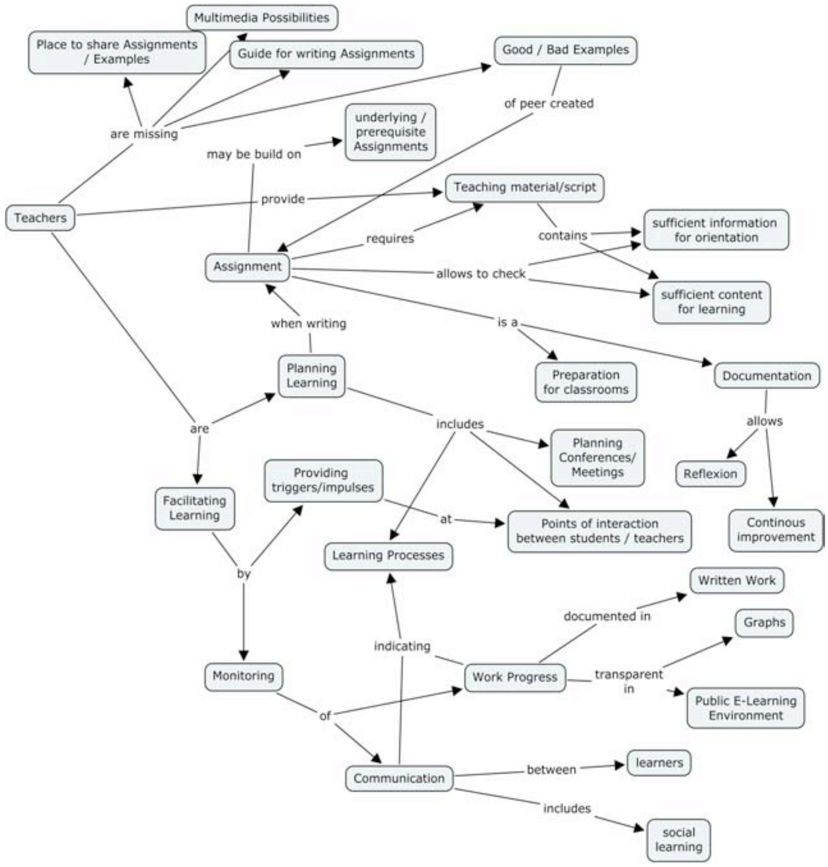

Figure 3: Elements of the teacher's new Role

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Georg Weichhart is researcher at the Business Information Systems / Communications Engineering department of Johannes Kepler University Linz. He received his masters degree at Vienna University in 1998. He worked as an engineer at a private software company and as project manager at a private research institute. He has been participating as researcher and software architect in numerous European research projects. His current research interest is e-learning support for Dalton Plan Education.

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Management of Sustainability

Sustainable Controlling

Manfred Blachfellner

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Abstract: *There will be no chance to achieve sustainability with commercial target systems currently used. For our economic system completely changed objectives arise with the consciousness for the common house Earth with his biodiversity as the only basis of all known live including the humans. A new definition of economically advantageous will have to care for equally value creation to the company, the environment and the society instead of the unilateral orientation to shortterm financial profitability. For this purpose a management model was created, combining ancient Indian wisdom of holistic decision-making with the stringent logic of consequentially reasoned assumptions, outcomes and values. The real constraints are in our brains. To tap the full potentials of employees and business partners, sustainable thinking entrepreneurs develop a culture apart from the paradigm of absolute competition towards cooperation on all internal and external levels with the ambition of creating even better contributions to the preservation of our life bases.*

Keywords: sustainable economic; commercial target system; economically advantageous; value creation; financial profitability; constraint; competition; cooperation

About the Author

Manfred Blachfellner

Manfred Blachfellner is one of the co-founders and active ambassadors of the international Change the Game Initiative, Member of Bertalanffy Center, Member of International Controller Associations Ideas Workshop and several research groups. He was group controller and investment manager in an Austrian industrial holding company. He is especially interested in sustainability, corporate social responsibility, leadership, innovation, value creation and systems thinking.

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Entrepreneurial Subcultures as Spurs of Innovation

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Abstract: *The paper deals with the current trends in innovation eco-systems, the formation of new organizational structures in an emerging social fabrique, entrepreneurial sub-cultures.*

In many countries entrepreneurs gather and co-create new structures of mutual support almost ignoring the established infrastrutures of interest groups and markets. This ignorance becomes bliss if an entrepreneur aims at radical innovations changing the rules of economic games, or entrepreneurial designs in social and cultural innovations. It seems to be the verge were life develops its abundance, the spurs for co-evolving patterns in the next steps of (social) evolution. Pradigm change seems to be in need of this new structures called e.g. innovation hubs, co-working spaces, barcamps, Pecha Kucha, and in need of the vibrant mix of arts, economics, and science. Thus societies which enable entrepreneurial sub-cultures to emerge and enable entrepreneurial sub-cultures to disturb the established fabrique might find the next evolutionary advantage.

The research project in progress examines the conditions in which these co-evolving structures emerge and the impact they cause, in the context of complex systems and evolutionary systems theory and evolutionary design patterns.

Keywords: entrepreneurial; subcultures; evolutionary systems; complex systems; evolutionary design; emergence; co-evolution

About the Author

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Stefan Blachfellner was born in 1970 in Innsbruck, Austria - graduate at the University of Salzburg, studied Communication, Management and Social Psychology and Economic and Social History.

He is a communication and business designer with broad experience in industries and the service sector as well as in public administration and cultural and educational organizations. He is co-founder of the international hub Change the Game Initiative for Innovation, Ethics, and Leadership.

He teaches at four universites in Austria, is a member of several scientific communities and organizations dedicated to systems research and innovation, and serves several scientific publications as editorial board member and guest editor.

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Innovation from the Core

Emergent Innovation

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Abstract: *This presentation pursues the question, how social systems (organizations, communities, etc.) must be designed so that innovation is anchored within its core. Contrary to the view, that innovation is something that must be added or done at some (random) occasions, the author´s view is that innovation is a permanent "driver" that pushes organizations forward, may it be incrementally or radically (this decision as well stems from the organization´s core). Therefore, innovation is deeply rooted in the organizational culture; it is not another department, such as marketing or controlling.*

Keywords: innovation; emergent innovation; sustainable futures

About the Author

Thomas Fundneider

Thomas Fundneider is founder and CEO of theLivingCore, specializing in the areas of strategy, innovation and transformation. Having his background in landscape architecture/planning, he is obsessed with details that make a difference. This design attitude is coupled with a highly structured and rigorous way of working that stems from managing several technology projects. He has vast experience in establishing an innovative and entrepreneurial culture and mindset in organizations. Driven by his ambition to "get things done", his focus is to create impact for clients. He is member of the Board of the Austrian chapter of the PDMA, the world's largest support organization for product development and innovation.

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Do High Performance Work Systems Contribute to the Thrivability of an Organization?

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Abstract: *High Road to Innovation approaches in general and High Performance Work Systems (HPWSs) in particular are considered to have great potential to generate competitive advantage in terms of productivity and innovativeness. High Performance Work Practices (HPWPs) entail a transformation to a holistic organization that features self-managed team-work, flat hierarchical structures, job rotation, performance-related wages or workforce empowerment to create an organization based on employee involvement. Scientific discussion of HPWSs has not referred much to systems theory, although systems theory (in particular the complex adaptive systems perspective) might provide fruitful insights into the underlying principles and structural conditions of HPWSs. In this paper we present our research on HPWSs and our endeavor to include systems theory in this work. Furthermore we describe a possible effect of HPWSs on the organizational culture and decision making, in particular with regards to sustainability issues and corporate ethics*

Keywords: high performance work systems; high performance work practices; systems theory; complex adaptive systems; sustainability; thrivability; frames; values

1. High Performance Work Systems and Systems Theory

In theoretical and practical discussions about, how companies can maintain or gain competitive advantage in a globalized and highly volatile economy, “high road”-strategies that focus on innovation and agility – and here in particular “High Performance Work Systems” (HPWSs) – are considered to have great potential. HPWSs focus on continuous reinvention processes of products and services integrating creativity, experience and implicit knowledge of employees at all levels. HPWSs comprise of particular management practices (“High Performance Work Practices” – HPWPs), concerning the organization of work and the company itself, like self-managed teamwork, flat hierarchical structures, job rotation, performance-related wages or workforce empowerment. As opposed to tayloristic principals, HPWSs lead to a fundamental reorientation in operational rationalization efforts resulting in a new and increased appreciation of human work. In this context, the aspects “self-control” and “self-organization” are of particular importance. HPWSs, which are also known as high commitment or high involvement organizations, realize a managerial approach that facilitates high performance of employees and thus illustrates the amended character of work and the options of work sharing and knowledge sharing in today’s knowledge-based economy (Brödner, 2000, p. 3).

So far, HPWSs have primarily been applied and studied in a context of industrial production and there is ample empirical evidence about the impact of HPWSs in these environments with regards to higher productivity, stronger financial performance (Kuhlmann *et al.*, 2004, Combs et al. 2006), increased organizational agility and innovativeness (O’Regan, 2011). Empirical research has also shown that systematical implementation of HPWPs by means of reorganizing the entire work system and not only individual practices (‘bundling of work practices’) is a key element to achieve these positive effects (Appelbaum *et al.*, 2000; Kuhlmann *et al*., 2004,).

HPWSs have been discussed in the fields of labor economics, industrial relations, (industrial) sociology, organizational behavior, strategic HRM and operations management. However, in our literature reviews we have not come across any specific reference to a systems theory approach so far, although systems theory (in particular the complex adaptive systems perspective) might contribute fruitful insights into the underlying principles and structural conditions of HPWSs.

From the field of systems theory Michel Saint-Germain has linked HPWSs to the nature of open systems:

> *"[T]he individual as an open system is respected in such organizations. He/She is able to transform data into useful decision-making information. There is margin for creativity and autonomy and above all, the decision-making process allows opportunities for a 'locus of control' at the individual level" (St-Germain, 2010, p. 10).*

2. Design of the research project

Having started in 2010, we are currently conducting a combined research project in the Austrian manufacturing plant of a global player in the automotive industries (company A, approx. 2000 employees) and at the Austrian production site of an international high tech company in the metal industries (company B, approx. 1.000 employees) to determine the impact of HPWSs on the adaptability of organizations to volatile environmental conditions such as turbulent markets. In this context we have developed the concept of "Organizational agility" and we have introduced this to the scientific discussion in the field of Operations Management in July 2011 (Menrad & Wallner, 2011).

In company A the main scope is the scientific accompaniment of the implementation of various HPWPs on the shop floor. We monitored the process of a pilot implementation, evaluated the effects and will again do the accompanying research when the measures are rolled out on the entire shop floor, which will happen in 2012. Further activities include a complete reorganization of operational management towards flat hierarchies and innovative approaches of integrating relevant areas on the shop floor into process-oriented structures. Thus, various HPWPs are being implemented in a systematic way and the bigger part of the plant will be involved in this project; in total 1.200 employees will be included in the project.

In company B we evaluate already existing forms of HPWSs, which are there organized in a company-specific production system.

Furthermore we are investigating in both companies whether HPWSs and organizational concepts like Productive Ageing are compatible and of mutual benefit. In addition we are also performing explorative research about the applicability of HPWSs in other areas besides production such as production logistics and R&D departments.

We have set up a multistage research process that relies on a combination of various sociological data collection analyses and methods. We tie this selection to the requirements of the case study method associated with industrial sociology to make sure that we fully understand the differences between the social processes and the company context it is embedded into. We understand that this approach is especially applicable when researching and evaluating the implementation and the effects of new forms of labor organization. In this process we want to introduce a systems theory perspective in the scientific discussion. We assume that systems theory can provide the theoretical framework to explain how and why particular HPWPs and HPWSs in general work (and contribute to the innovativeness and adaptability of an organization) and help to formulate the guiding principles for a further development thereof.

3. High Performance Work Systems and Sustainability

Since sustainability is a strategic research topic in our department, we also want to find out whether HPWSs do have an influence on the organizational culture and decision making, in particular with regards to sustainability issues and corporate ethics.

There are some suggestions that this might be the case. HPWSs respect employees as open systems, as purposeful beings. In HPWSs employees can develop and deploy their competencies and creative potential; they are able to assume responsibility and engage in opportunities for analysis, problem solving and innovation, in which the working environment is a place of learning (Totterdill, 2008, p. 133). In HPWSs employees develop a competence to make decisions; they learn that their decisions have an impact, that their contributions matter, that responsibility is to be taken on an individual level. This is a prerequisite for responsible ethical action.

> *"[E]ven if people fully develop their potential, they cannot give direction to their lives, they cannot forge their destiny, they cannot take charge of their future – unless they also develop competence to take part directly and authentically in the design of the systems in which they live and work, and reclaim their right to do so. This is what true empowerment is about" (Banathy, 1996, p. vii).*

In specific, we plan to investigate whether employees, working in a High Performance Work Systems environment change their mental frames and adopt a set of more intrinsic values over time. The rationale behind this interest is as follows: Research on motivation shows, that people's values tend to cluster in remarkable similar ways (this has been validated across cultures): Some sets of values can easily be held simultaneously while others oppose one another (Schwartz, 2005). Intrinsic values (those, which are inherently rewarding to pursue, because they are good at satisfying people's psychological needs, including personal growth, emotional intimacy or community involvement) act in opposition to extrinsic values (contingent upon the responses of others, including power or financial success). Intrinsic values are associated with concern about bigger-than-self problems and with corresponding behavior to help address these problems (Crompton, 2010, p. 10). Thus, HPWSs may be a means to support thriveability in organizations.

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Thomas Wallner holds a Professorship for System Thinking and Supply Chain Management at the University of Applied Sciences in Steyr, Austria. His experience includes 20 years of Business Consultancy and Management Training for automotive industries, public services and retail. He developed and executed innovative training programs for international companies like BMW Group or METRO International. He is currently project manager and co-leading scientist in a major research project on the application of High Performance Work Systems in the automotive industries in Austria. He was and still is a co-developer of the KEU-Leadership Program at the University of Applied Science in Steyr, Austria, which attempts to integrate aspects of creativity, decision making and implementation into academic teaching. He is also a lecturer and thesis supervisor at the University of Applied Sciences of the bfi in Vienna. Holding a J.D. from the University of Vienna he studied Physics, Communication, Political Science and Law in Vienna and General Management in New York City.

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Mass Innovation – An Enabler for an Open, Prosperous Society

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Abstract: *Experience is encouraging me to believe that, for innovation to become a value facilitator of change on a corporate or a community level, we need to develop and to launch a comprehensive system of policies, enablers, tools and deployment mechanisms that will support strong horizontal cooperation, combining of top down and bottom up approaches. Top down approaches will be effective only when strongly supported by mass, bottom up innovation movements. I will share the experiences of the InCo movement in Slovenia that directly involved over 5000 people over 5 years, in diverse innovation related activities. The InCo movement is a prime example of how different participants of the innovation ecosystem can successfully cooperate together to serve the higher good. I will argue that mass innovation is an important enabler for an open, prosperous society, for sustainable development and success. In addition, I will encourage governments to stimulate mass innovation engagement by the public, including social innovation, in order to facilitate a break-through into innovation excellence. I will propose that more cultural characteristics and local core competences be included in the bottom up innovation approach. In addition, I argue that international practice should be adopted locally, with a high level of sensitivity for local culture and local experiences, with a greater engagement (on innovation).*

Keywords: innovation ecosystems; mass innovation; innovation movements; open society; social innovation; local culture

About the Author

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A founder of Vibacom (www.vibacom.si), expert on balanced sustainable development strategies, organic growth and innovation ecosystems. She believes in the power of networks, holistic individual, and positive energy. She is a member of management and supervisory boards of several professional associations (UN Chapter of Global Compact in Slovenia, Manager Association, Umanotera, Change the Game global initiative). She is also a member of Slovenian National Council for innovative society and an honorary member of Association of Slovenian Innovators. Among her special achievements is initialization and coordination of “InCo movement”, a civilian initiative, connecting Slovenian professional community, as well as, systematically raising the awareness on innovation among the youth (www.incomovement.eu).

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Developing Resilience in Project Teams

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Abstract: *This paper relates to Symposium T, "Enabling organizations for thrivability: New perspectives on form, structure, and process in favor of human and societal prosperity." It focuses on the question, "What could we possibly achieve if we co-create radical innovative patterns together, learning from other practitioners who are experienced in biology, technology, sociology, management, development, design, and ...?" Based on project team research viewed through a lens of complex adaptive systems and an adaptive model used in ecology, I will address "thrivability" in terms of collaboration, innovation, and learning. Specifically, my objective is to explore how project teams collaborate to co-create value as complex adaptive social systems in a multidisciplinary environment. In addition, innovation is explored as the impetus of creative destruction and its outcomes. Further, organizational resilience, specifically through development of adaptive capacity, is revealed as an outcome of learning through leveraging multidisciplinary experience.*

When one "thrives", it means one is "to grow vigorously (flourish), to gain in wealth or possessions (prosper), and to progress toward or realize a goal (succeed). It may be understood as a step beyond sustaining, which implies nourishment, support, preservation, and maintenance. Organizationally, thriving can mean expanding resources, expertise, productivity, and profitability. Beyond maintaining an operational model, our organizational objective, in this discussion, is not to merely sustain but thrive. In other words, humanistic values are not only the baseline for ethical decision making, but inform how an organization operates in time and space (i.e. daily, locally, and globally).

When goals are not specifically defined, but are questions of "what could we possibly achieve," there is inherent risk in not knowing what to expect. A systems perspective can be valuable in defining the boundaries of the systems, its context, stakeholders, and impacts through useful tools such as feedback. For example, the mission set out in the question of "what is possible" can be framed within a context of ethical and social responsibility, given the nature of the mission's objectives. Such an open-ended mission is challenging, especially to project managers, who often have an aversion to committing to amorphous goals, much less in terms of co-creation of radical innovative patterns across disciplines. As a former project manager, I take a practical approach to most issues with which I am confronted. As a result, my question is, "In practical terms, how can we achieve this mission?"

One reason this mission is challenging per se, is that the introduction of "radical" ideas provokes resistance in most organizations, especially those that are change adverse. It also requires dialogue across disciplines for exploration of models that may provide insight into issues that have not traditionally embraced concepts outside the confines of one discipline. This requires impartiality to a practical application of theoretical pluralism for the purposes of learning different approaches to problem solving. It also requires establishment of trust in the process of emergence of new ideas, concepts, and models of design, problem solving, and delivery.

In organizations resistant to change, a crisis (significant adversity) is sometimes necessary to prompt transformational change. Members of the organization are asked to reflect upon what is not working. Processes left unexamined after long periods are possible sources of obstacles to progress. Rigidity, in the forms of tight command and control through hierarchical structures and formal processes, binds resources to behavioral norms that have become inculcated in the organizational culture. A crisis prompts questioning these structures, which can result in a type of creative destruction. This type of creative destruction releases norms that no longer serve the organization in favor of new behaviors and processes that support its goals and objectives (norm negotiation). It can also be a precursor to creativity and innovation.

Research exploring the dynamics of group development and ecological adaptation has shown that resilient organizations encourage development of adaptive capacity. Practically, adaptive capacity is operational flexibility that allows for risk taking, questioning standard operating processes, and learning from experience. The lessons learned are then incorporated into future projects and reorganization of resources. Project leadership plays an essential role in shifting group norms and processes to promote adaptive capacity. Embracing change (incremental and transformational) and trust in the emergence of innovation are hallmarks of organizational resilience. Project teams that have developed adaptive capacity become leverage points as sources for organizational resilience and, subsequently, a path toward thrivability.

Keywords: Complex adaptive systems; group development; socio-ecological systems; theoretical pluralism; adaptive cycle; creative destruction; leadership; innovation

Acknowledgements: Stefan Blachfellner, Ockie Bosch, Alexander Laszlo, Gary Metcalf, Nam Nguyen

About the Author

Mary C. Edson

Mary is an organizational and social systems scientist with a research focus on resilience in project teams using mixed methods and theoretical pluralism. She is a scholar/practitioner with project management experience in information systems, healthcare, financial services, organization development, and human resources. Mary's executive and group coaching practice provides developmental tools for building resilience and adaptive capacity for successful achievement of organizational goals.

PRESENTATIONS AND PUBLICATIONS

A Systems Perspective of Resilience in a Project Team (July 2011) presented at the 55th Annual Meeting of the International Society for the Systems Sciences at the University of Hull, United Kingdom - Sir Geoffrey Vickers Award for Best Student Paper

Summary of the Fourth Annual Workshop and Open Symposium on Service Systems Science at the Tokyo Institute of Technology (with Kyoichi Kijima) (July 2011) presented at the 55th Annual Meeting of the International Society for the Systems Sciences at the University of Hull, United Kingdom

Group Development: A Complex Adaptive Systems Perspective (July 2010) presented at the 54th Annual Meeting of the International Society for the Systems Sciences at Wilfred Laurier University, Canada

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Symposium U. Global Crisis: Transitory Exogenous Shock or Unavoidable System Dynamics?

Chair: Manuel Wäckerle, Vienna University of Technology, Austria

Is it possible to describe the global economic and financial crisis in cybernetic terms? Was the crisis triggered by chance or are there essential feedback mechanisms which drive the system into difficulties? Are there pathways out of the crisis? What are the necessary emergent features to improve global welfare?

Peter Fleissner: *The Global Financial Crisis from a Dwarf's Perspective: Austria's Contribution*

Stephan Schulmeister: *The Current Crisis as Implosion Process*

Hardy Hanappi: *Ten Commandments for Europe's next Ten Years – A Nucleus for a Systematic Program for a Progressive Political Economy*

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The Global Financial Crisis from a Dwarf's Perspective: Austria's Contribution

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Abstract: *The economy is reconstructed using an evolutionary model of multiple strata, starting on an abstract level, and adding more and more concrete features. The schema is to explain political directions of economic development. Austria can be taken as a typical example for the Northern Member States of the European Union. High productivity gains, but stagnant wage incomes allow for high profits, but investment remains low. Capital income is used for financial investment. Financial capital produces bubbles, bubbles explode, driving banks into break down. They are bailed out by state money. Tax payers have to shoulder the burden of ever increasing public debt, restricting growth rates within the members of the European Union.*

Keywords: Financial crisis; evolutionary economic model; financial engagement; Austria

About the Author

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Born 1944 in Austria. 1990-2006 Technical University Vienna, chair of “Social Cybernetics”. European Union: 1997–2000: Department Head "Technology, Employment, Competitiveness and Society", Institute for Prospective Technological Studies (IPTS), European Commission, Seville, Spain; 2000–2004: Department Head "Research and Networking", European Monitoring Centre on Racism and Xenophobia (EUMC), Vienna, Austria. Before, he had worked for the Austrian Academy of Sciences and for the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria; member of German Leibniz Association. Further information: http://members.chello.at/gre/fleissner/default.htm.

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The Current Crisis as Implosion Process

Stephan Schulmeister

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Abstract: *The great crisis is the final product of that type of a market economy, which can be termed „finance capitalism". It is characterized by many interlinked framework conditions like the dominance of the neoclassical/neoliberal paradigm („laissez-faire"), the deregulation of financial markets, the attempt of an ever increasing number of people to make money out of money („let your money work"). The development of the crisis marks the stepwise implosion of this system.*

Over the 1950s and 1960s, by contrast, striving for profits („the core energy of capitalism") was systematically focused on the real sphere of the economy ("real capitalisms"). At stable exchange rates, low interest rates, stable commodity prices and almost „sleeping" stock markets, profits could only be made through truly entrepreneurial activities (in a modified from this model is operating in emerging market economies, in particular in China where policy keeps control over exchange rates and interest rates).

The years ahead will be shaped by the difficult and long-lasting transition from „finance capitalism" to a new form of „real capitalism" (the transition will in many respects be similar to the period 1929 to ~1950 - though less extreme). The extremely low speed of learning on behalf of the elites will make life much more difficult for many people.

Keywords: Euro crisis; monetary union; dynamic budget constraint; finance capitalism

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Key area of research: Instability of financial markets and its impact on the real economy.

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Ten Commandments for Europe's next Ten Years

A Nucleus for a Systematic Program for a Progressive Political Economy

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Abstract: *The project of a common European political and economic union is rapidly approaching crossroads at which it will be decided if it can survive or split up into diverging areas. After briefly evaluating why it is welfare enhancing (for European citizens as well as in a global perspective) to support Europe's survival, the contribution proposes 10 immediately necessary policy measures to be taken. In a more elaborated paper these urgently needed measures will be brought into the context of a consistent mid-term program for Europe, which then also entails a long-run vision for Europe's place in the world economy: A pilot project Europe.*

Keywords: Political economy; system change; contradictions; evolutionary economics

About the Author

Hardy Hanappi

Starting in the early eighties Hardy Hanappi has been working as a scientist in the areas of information science, game theory, and political economy (including economics and political science). Most of his works in all of these fields have been published and are available for download on his website. He also has been project leader of a large number of research projects, and has been teaching and researching mainly in Vienna (TU Vienna, Austrian Academy of Sciences, Ludwig Boltzmann-Institute for Monetary Economics) and London (University of London - SOAS). His most recent focus as an ad personam Jean Monnet Chair for Political Economy of European Integration is on simulation modeling of the dynamics of Europe's political economy.