

Knowledge and Conceptual Information

Two Faces of Reality - Cognition, Ideas and co-evolution

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Abstract

Despite of a whole series of proclamations on how a information is important and needed, the whole concept of information (incl. questions covering the origin of the information or its meaning) is actually still quite fuzzy and misty.

Keywords: Conceptual information, information, knowledge, reality, self-organization, social reality, system,

The 'information explosion,' about which so much has been said and written, is to a great extent an explosion of misinformation and badly organized information.

Murray Gell Mann,
Information versus Knowledge and Understanding, 1995

Introduction

Our effort to characterize dramatical changes coupled to the development of modern world and society is usually accompanied with plenty of new terms and trends, however they seems to miss the heart of the matter /point. Some of them are just metaphoric (*global village*) or attention-catching slogans (*digital economy*). However since the middle of 60's we can clearly trace persistent conviction of growing importance of the information within the society – usually connected with the term “information society”. This trend follows fast development of information technologies (IT) and confidence, that implementation of IT will /must/ facilitate (information) problems of management, entrepreneurship or public administration. As time passed by, the question of satisfying information needs turned into the over saturation nightmare, as the volume of information boomed/exploded.

About 30 years ago the emphasis has shifted and the accent was put on knowledge and its management. Number of popular slogans changed its adjective and attribute “communi-

cation” was added to IT, creating an ICT. Along with that, new and important trend emerged – management of knowledge – connected mainly to business and economy. Within this trend of knowledge management two different branches subsequently separated: one is closer to the use of ICT (typically data mining), second is oriented towards humans (human capital) or organizations (organizational learning). However, some authors [e.g. Wilson, 2002] point out to the unrealistic expectations and following disappointment of these trends (e.g. reengineering). In this sense – at first sight paradoxically – some prominent authors from this field warn us, that „...*knowledge cannot be manager only enabled.*” [Krogh, Ichijo, Nonaka, 2000].

In parallel with these thoughts we appreciate more and more the reflection of global world (with global problems) usually hidden under the term globalization. Troubles of globalization are much broader, and far less optimistic, than original ones concerning information society. The emphasis is put on increasing complexity, turbulence of environment and the ability to deal with it. That is why demands for new way of thinking (re-thinking) appears, however they seem to be rather proclaimed than really achieved. The related changes usually shatter on the need for complete change of paradigm and pragmatic (sceptical) approach so typical for our contemporary society.

We are convinced, that necessary changes are linked to quite different concept of *reconceptualization* of the terms like “information” “knowledge” and “system”. This triplet of terms is entirely interconnected. We will demonstrate the importance of information for evolution (self-organization) of systems and its (circular) relation to knowledge. Let us remind you in this context, that we do not challenge the importance of information neither communication technologies and/or information system in the processes of globalization and overall society shift/trunover/transmutation. However, proper and clear understanding to the specific nature of information provides us with whole series of new unexpected views, implications and problems. For instance, the traditionally unclear idea of the trueness of information (or more precisely dichotomy information / disinformation) and related conviction, that (greater volume of) information reduces uncertainty.

Both above mentioned communities professionally interested in information and knowledge (information systems / informatics and knowledge management) are unfortunately in a essential disagreement on the fundamental principle of the phenomena they should have in common – information and knowledge.

Information: Familiar, Misty and Versatile Concept

Despite of a whole series of proclamations on how a information is important and needed, the whole concept of information (incl. questions covering the origin of the information or its meaning) is actually still quite fuzzy and misty.

One of the reasons, why it is so, is still existing influence of dualism, which separates material and immaterial (mental) phenomena and processes. At first sight we can blame for that famous Wiener [1954] opinion on information, that information is **content** of what we interchange with the outer world. And moreover his proclamation: *Information is information no matter, no energy* [Wiener, 1948].

Another confusion brought the conception of information as a inexhaustible source (for the first time in Naisbitt's Megatrends). This is probably origin of theory, that information is a thing (substance) we can store and process by technology similarly to the other material entities (raw materials). In this theory information turns into commodity we can trade and posses. Although it is not explicitly stated, in this theory is information is considered to be of material essence.

On the other hand, theories connected to the traditional information theory (of qualitative orientation and uncertainty/entropy reduction) are generally refusing material essence of information and deal with the matter (relation of real world and information) through the special term “representation”. This is mainly because some of the implicit (and very basic) presumptions of such theories – above all Shannon's theory [Shannon, 1948] – are overlooked or even consciously omitted. Just a few understand the nature of discrete symbols and their relation to letters on which these theories are build or take into consideration Weaver's own criticism of the Shanon's [Shannon & Weaver, 1949] theory. Weaver did not approve that Shanon's theory is being taken for information rather than just communication theory, as well as complete ignorance of the information's meaning.

Such abstraction/oversimplification is present also in the famous Maxwell daemon theory (daemon that controls the flow of slow/fast molecules between two parts of the vase). The questions of daemon's intentionality and observation possibilities remain unanswered.

These are the roots of modern day confidence, that increasing volume of information reduces uncertainty/entropy. However, the issues of representation or discrete distinction (binary code) – which are not in accordance with the entropy reduction – are basic and fundamental for modern computing in the way a computer process/treats the information.

Although the theories based on entropy reduction are unclear and they seems not to correspondent to the reality (for instance they define world/system just as limited set of possible states), they seems to survive in general public. As a result of it people are convinced, that growing accessibility/availability (in terms of volume and speed) of information through IT/ICT can actually improve/enhance our life/agency.

Majority of people understand information in common, anthropic sense – just as a message or news, without thinking about information beyond social systems (e.g. DNA).

We are conducting extensive empiric research in the Czech Republic, at the moment, focused on understanding of information and knowledge in the Czech business environment – as applied in management, entrepreneurship, and public administration (project No. 409025 supported by Czech Science Foundation. We are still in the process of evaluation of results, however we can say even now, that two approaches clearly prevail.

It is the concept of information as a object/commodity (19.2 %), reducing uncertainty/entropy 21.0 %. Other important concepts were – information as a message/news (10.8 %) and as a part of a chain Data-Information-Knowledge (11.4 %). Detailed results, incl. cross references to the occupation or education of respondents, will be presented in the course of time.

As we mentioned above, results prove that majority of people (mostly professionals) understand information in common, anthropic sense – as a message, news, documents – without actually distinguish between information (knowledge) and data. They seem to ignore the differences between information in social systems and processes (incl. management and business) and other types of information (e.g. DNA information). Respondents also seem not to care much about the source of information, their importance, relevance and truthfulness, which are very important in the light of our current “information explosion” and “digital revolution”.

This proves one thing – in our current popular paradigm is quite hard to understand information in the sense of “*human information*” as Stonier [1990] puts it. Modern system theory, second order cybernetics and their “Unified Theory of Information” are able to deal with mentioned problems, however major paradigm shift is required to accept it.

Systemic Thinking as a Paradigm Shift

To begin, we should anticipate, that we understand paradigm in broader sense than how it was originally defined by Kuhn [1970] in the relation to the scientific revolutions. In our broader terms, paradigm „*becomes the reflection of Weltanschauung and the invisible patterns that guides the construction of theories, methodologies... and even beliefs, justified or not by reasoning*” [Francois, 1997].

In this sense, paradigm is culturally shared and formes “meta-knowledge” creating framework of common knowledge and conceptions. Principles of this paradigm were created by Descartes and his “scientific methodology”, enabling and influencing industrial revolution. This paradigm is rooted in our educational system, which carries it on, not reflecting enough the changes of modern science.

In such cultural framework we blend together everyday empiric experiences and pragmatically accepted scientific discoveries/knowledge. Their significance is determined in strictly utilitarian way, in accordance to the utility it has for us. The utility is derived from such unclear terms as “progress” or “welfare”. We can mention are also some others assumptions of this paradigm:

- Rationalism – as a belief in reason – a mixture of abstract cognition and intentionality. Its cornerstone of above mentioned utilitarianism.
- Newtonian concept of time and space – derived from direct human observation / experience. The trouble is, that time/space is continuous, however measured in discrete units. The result is abstraction and static concept of the world (system) ... just as a sequence of possible/measured states.
- Causality and determinism – through which we describe the evolution as a linear sequence of states/conditions – determined by rules and regularities. This is, what we understand under the term “order”. Unlike chaos and spontaneity, order is related to the human cognition and ability to predict.
- Reductionism – as a result of the limitations of human cognition. Analysis as a breakdown to smaller parts we can handle. Holistic properties are then extrapo-

lated mechanically – based on causal and deterministic models. This is quite successful in case of artifacts, however fails e.g. in the case of management.

However, these principles are in conflict with modern (advanced) system science and cybernetics. The union of both these disciplines accents the difference between human cognition and real (material) world.

Human being is considered to be an organism (biological system), which interacts within particular environment and through such interaction creates/forms its knowledge.

The biggest difference between this and classical anthropic approach is, that in this conception the human being is part of the environment (is not excluded) and his knowledge affects (while being affected by) environment. This is why in classical anthropic approach we can for instance distinguish dualism of the truths – *correspondence truth (in correspondence with reality) and coherence truth (by the rules)*.

Ability of abstract thinking is bound to the usage of symbols and differs us from all other animals – Cassier [1929] calls human being *animal symbolicus*. We share and shape (re-shape) our knowledge (and paradigm) and via symbols. In this context, we must mention Theory of dissipative structure [Prigogine, 1980] and theory of Autopoiesis [Maturana, Varela, 1997]. These theories form new principles and constitute new vision of the world:

- Evolutionary approach is based on materialistic conception of the world (with respect to cognition and mental processes) and its spontaneous development. It goes behind Darwinian theory and explains it as a process of self-organization, self-maintaining and possibilities of changes.
- Dynamic balance/equilibrium respects material structures, that fluctuate around abstract (from the point of observer perceived) patterns. Meanwhile common fluctuations does not change the patterns, in rare - but possible – conditions (synergy, surplus of energy,...) they can change quality or identity of the system. The number and amount of fluctuations contribute to possible (revolutionary) change, associated with the conception of emergence.
- Recursion and circularity is the most significant result of feedback. It has 2 serve consequences: 1) Nature and behavior of complex systems does not depend only on external environment, but also on historical development (its own past states) ... and thus 2) there is no simple and deterministic causal relationship – linear chain of “cause – consequence”.
- System hierarchy and complexity respect the fact, that all the systems are interacting with other systems, their components are also systems ... It explains in complexity the relationship between the whole and its part and between environment and the system. It results in reflexion (rather than understanding) of complexity as a dynamic uniqueness of the world.
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On these systemic principles is founded Unified Theory of Information [Hofkirchner,] which observe information as a founding aspect of evolution and complexity.

Dynamic Information: Patterns and Concepts

Proper adoption of systemic paradigm distinguishes natural world – which exists independently on human observer and his cognition (but can be by him). In this sense, information exists also in pure physical systems, in the sense of spacial and chronological versatility of physical structures. As Stonier [1991, p. 19] put it:

Information exists. It does not to be perceived to exist. It does not be understood to exist It requires no intelligence to interpret it. It does not have meaning to exist. It exists.

He opens important question of physical nature of information. This is far away from classical anthropic approach, where information is bounded to intentionality of human consciousness.

Stonier connects information with versatility on the level of physical systems – thus talking about different physical structures (systems). The physical structure of the matter which is created in particular environment, under particular circumstances and keeps (relatively stable) pattern, can be described by the means of discrete symbols. Let's take for example two different physical structures, both being composed of Carbon and Oxygen – CO and CO₂. Both structures consist of the same “matter”/ chemical elements, however they have different qualities when in interaction with its surrounding environment (outer system). This interaction is actually an ex/change (chemical reaction) as well as the fact, that in other environment the structure is not stable and decays. Example of which should be an oxygen molecule – in normal environment it is O₂, however in stratosphere it creates ozone – O₃. The meaning of information is perceived as a change/alternation in interacting structures. This is in accordance with what Gregory Bateson [1972, p. 453] said:

In fact, what we mean by information – the elementary unit of information – is a difference which makes a difference, and it is able to make a difference because the neural pathways along which it travels and is continually transformed are themselves provided with energy. The pathways are ready to be triggered.

Please note, that the meaning is tied to unique relation of matter and energy and versatility per se, expressed just by symbols, does not have in real (physical) world any meaning. However it can easily change our understanding of this world. And vice versa - “meaning” in physical sense exists independently to the human cognition/knowledge: for instance DNA (sequence of triplets of four nucleoids A, C, T a G) have determined all living things long before being discovered by mankind, exactly as well as it determines it now.

Discovery of DNA points to the other important fact concerning information. It is the ability to react accordingly to the versatility of outer environment. This feature increases along with complexity of organisms (emergence of receptors). The result of such reaction to the outer environment however is not the change of physical structure, but “just” change of behavior. In relatively simple organisms such change is quite deterministic

(sun-flower turns towards the light source), but with growing complexity of organisms, nerve system appears, and we can trace symptoms like intelligence and privity - Stonier, T. [1992], Mingers [1995].

Critics of antropism rise the question of uniqueness of human brain and cognition. Other questions include terms like awareness, sense, consciousness and/or knowledge, closely linked to the aspects recently explained by systemic principles. The most famous is probably Autopoiesis from Maturana and Varela [1998], which talks about language and knowledge. Authors accent dynamic nature of both phenomena by using terms “*knowing*” and “*languaging*”. Similarly Combs [2002] explains cognitive/mental processes by term (chaotic) attractor – processes *on the edge of chaos* reach over two dynamic stable states - Lorenz’s strange attractor.

In this sense we can understand human cognition, knowledge and behavior based on certain patterns, but at the same time creative:

The ability of a system to move in and out of chaos gives it a creative advantage. It is capable of shifting from a steady or cyclic routine to one that generates novel emergent properties, whether those be original ideas or perceptions, new patterns of behavior, or novel emotional responses.

Such attractants involve series of shallow basins or nodes and have double nature:

- The first ones are described as endocepts, which Arieti [1976] characterizes as „... *primitive organization of past experiences, memory traces, ...*” They are related to the thinking and points out their intentional aspects “ „(endocept) *does not lead to the immediate action and can not be transformed into language*“ and is indivisible¹).
- The second are connected to concepts (ideas that are coupled with signs and/or that can be externalized). In other words, concepts can be pronounced, written and be recognized by someone beside the author. Such signs (or symbols) could be primarily words of language, through we can share the concept.

These processes of self-organization go directly to the essence of conceptual information. Stonier [1990, p. 17] names it „*human information*“ and characterize it as follow:

In contrast to physical information, there exists human information, which includes information created, interpreted, organized or transmitted by human beings. The term includes ‚data’ on the one hand and ‚knowledge’, ‚insight’ and ‚wisdom’ on the other. A datum is a small chunk of information. Usually the term information is thought of as organized data or ‚facts’ organized into a coherent pattern.

¹ However Arieti does not belong among the systemic authors, his ideas (presented 30 years ago) are very similar to the systemic principles. His conception of endocept and memory traces makes it clear. This term is used by the number of cognitive psychologists. He thinks about memory as about the process – not static thing like PC memory.

Also Liane Gabora [2003] goes into internal self-organizing processes within nervous system and points out *symbolic threshold*. She expounds an emergence of abstract, symbolic thought and connects them with ideas, concepts and also with *phenomenal information*. Let's remark, that phenomenology considers only (empirically) perceived entities not in the way they really are, but how they appear to the observer. „*Sight and mind are affected by anticipations, prejudice, scientific information and metaphysical conviction of the subject*“ [Ubaldo, 2005]. Emergence of proper information constitutes threshold in evolution and complexity of the Universe.

Knowledge and (or?) Conceptual Information

Many authors – both from system theory and cybernetic connects above mentioned processes with implicit knowledge. Also authors in the field of knowledge management do so, the term “*tacit knowledge*” was coined by Polanyi [1967].

From the point of view of common information theory we can diversity of nerve system consider to be an information. However knowledge, because of above mentioned principle of circularity can be understood just as a dynamic process ²⁾ which modifies itself (old knowledge). Thus knowledge differs from diversity in following points:

- 1) Biological nature of knowledge explains its real nature and its core aspects: First of all it's the dynamic nature of cognitive process, that is linked to biological organism. The circular relation of implicit knowledge of individual and semantic or conceptual information. Our knowledge is formed in past, but affect our actions and activities, that result in consequences in future.
- 2) Intentional nature of knowledge, that gives us the possibility to evaluate. On material/biological level is the evaluation base on the scale good-bad according to the inner feelings.
- 3) Knowledge is not objective reflection of reality (representation of facts), but actively formed limited cognition. That is why Nonaka [1995] describes is as „*justified true belief*“
- 4) Implicit knowledge can be externalized by the symbols, *coupled with generalized patterns* that forms basic rules of natural language. Sharing of them is spontaneous and is generalized on the level of whole society, helps us to create paradigms, theories and (culturally) shared frameworks of knowing.

Externalized knowledge is the essence of conceptual information – information presented through symbols. Symbols are presented through signs (material entities) with agreed (generally understood) form and rules how to use them.

If the building stones of language are the words, and building stones of data are the signs, then knowledge is build by concepts. Knowledge is basic for interpretation of meaningful information.

The real importance of knowledge lies in activities base on in – either physical (visible) activities or mental processes (decision making, thinking). Figure number 1 demonstrates

² Similarly Miller [Miller, 1978] defines 3 types of information (within nerve system) - Information of the world outsider (2) Information about self and own parts and (3) Information from the past.

(simplified) these activities, and also points out the emergence of conceptual information and its mediated nature.

Such information with no direct contact with reality is transferred primarily between the people - through other people or through information technology. This is, why ICT has so big influence on the development of society and why – according us – social-cognitive aspects of computer bases information system are underestimated.

The figure shows two circular (recursive) relationships – the first one is process the second information. Process one involves self-evident (but often forgotten) process of human cognition and activities. Information one involves production of conceptual information (by observer) from social environment. However, this process is already affected by previous observer’s knowledge and intentions. Observer is receiving number of stimuli (black and white dots), however he can not assembly any new knowledge out of them, not until he recognizes known patterns/concept. All this is very flexible and done in context and according to the interest (something else will visualize the owner of the duck farm, something else gourmet in the restaurant). You can also notice, how the mediation of information affects other people in social process. We can clearly identify duck or rabbit on the picture and communicate that to the others.

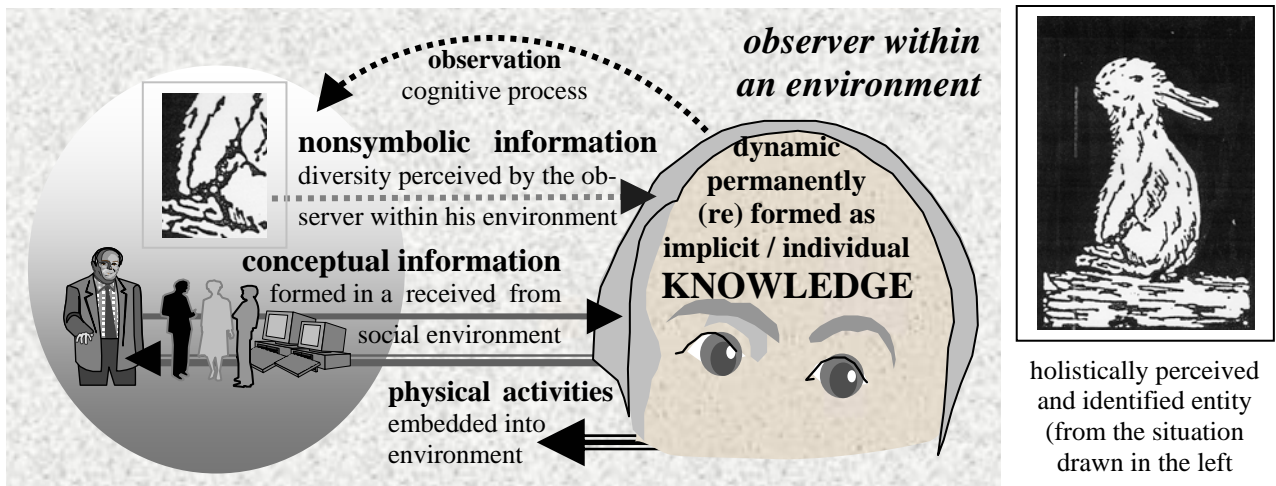


Figure 1. Active role of the observer within social and material environment point out two kinds of information and mediated nature of conceptual information.

Gabora describes unity of individual and social dimension of the knowing process when explains his above mentioned *conceptual threshold* between biological and conceptual level [Gabora, 2003]:

Although this account focuses on integration of the world-view through the abstraction of deeper, more general concepts, the principles apply also to the integration of the psyche through the purification of intentions and emotions.

For similar reason Winograd and Flores consider human knowledge as individual – not subjective, not objective. Processes of knowledge sharing are spontaneous, but important role in them play things like power-sharing, or used information technology. Let's have a look on information systems, educational systems or even system of institutionalized science.

All these processes are the result of evolution and emergence of language and conceptual information, which enables us to share knowledge and form social reality [Berger & Luckman, 1966]. In contrast to material reality, social reality is formed by knowledge, ideas, presumptions and wishes. It takes into consideration also culture and organization of society, as well as ICT. The view of Murray Gell-Mann makes it quite clear [Gell Mann, 1995]:

*The 'information explosion,' about which so much has been said and written, is to a great extent an explosion of misinformation and badly organized information. Yet we hear much more about how to disseminate the available material and transfer it from one medium to another than about how to separate the wheat from the chaff and extract meaningful conclusions. **The digital revolution has only made the problems more acute.**"*

Conclusion

Many from briefly sketched problems are not considered commonly and also some solution of some others seems to unacceptable from traditional positions. The opinions presented above are often minimized or ignored at least. Many replace skepticism by pessimism and do not take down “pink glasses”. However such pattern of thought presents acceptance of reality in the sense of critical thinking. Also reflection on misty concepts incl. information and/or knowledge comes under this group and better understanding their nature can bring sceptical thinking that is rather demonstration of responsible optimism.

References

- Arieti, S. [1976]: *Creativity: The Magic Synthesis*, Basic Books, New, York;:
Bateson *Steps to ecology of Mind*, Northvale, Jason Aronson Inc, 1972;
Bateson, G. [1970]: *Form, Substance and Difference*, in: *General Semantic Bulletin*, vol. 37, pp. 5-13;
P. Berger & T. Luckman [1966]: *The Social Construction of Reality. A Treatise in the Sociology of Knowledge*, Doubleday, New York, 1966;
Cassirer, E. [1929]: *Philosophie der Symbolischen Formen*, Bd. 1-3, Berlin;
Combs, A [2002]: *Consciousness: Chaotic and Strangely Attractive*, URL: <http://www.sourceintegrals.org/Strangely.html>
Gibson, R. (ed.) [1996]: *Rethinking the Future*, Nikolai Bredley Pub., London;

- Francois, Ch. [1997]: *International Encyclopedia of Systems and Cybernetics*, K.G. Saur, Munich, Germany;
- Gabora, L. [2003]: *Amplifying Phenomenal Information: Toward a Fundamental Theory of Consciousness*, URL: <http://www.vub.ac.be/CLEA/liane/>
- Gell Mann, M. [1995]: *Information versus Knowledge and Understanding*;
- Giddens, A. [1990]: *The consequences of modernity*, Polity Press, Cambridge;
- W. Hofkirchner, [1990] *The Quest for a Unified Theory of Information*, Gordon & Brecich;
- [Krogh](#) von, G. [Ichiijo](#), K. Nonaka, I. [2000]: *Enabling Knowledge Creation*, Oxford UP, London;
- Kuhn, T.S. [1970]: *The Structure of Scientific Revolution*, The University of Chicago Press, Chicago;
- Maturana, H. & Varela, F. *The Tree of Knowledge*, Shamhala, Boston, 1998;
- Miller, J. [1978]: *Living Systems*, McGraw-Hill, New York.
- Mingers, J. [1995]: *Self-Producing Systems - Implication and Applications of Autopoiesis*, Plenum, NY;
- Nonaka, I [1995]: *A Dynamic Theory of Organizational Knowledge Creation*, In: California Management Review, 5;
- I. Prigogine *From Being to Becoming: Time And Complexity in the Physical Sciences*, Freeman, San Francisco, 1980;
- M. Polanyi [1967]: *The Tacit Dimension*, Garden City, New York,;
- Rosicky, A. [1999] *Information within the (Human) System: Considerations Of Freedom, Power and Order*, in: Synergy Matter, Plenum New York.
- Rosicky, A. [2002] *Information generating system: Towards concept of information generating social systems*, EMCSR, Vienna;
- Rosicky, A. [2006]: *Circularity of Human Knowing and Systems Science*, prepared for 50th ISSS conference in Sonoma;
- Salthe, S. [2002]: *The Natural Philosophy of Ecology: Developmental Systems Ecology (Infodynamics)*,
<http://www.nbi.dk/~natphil/salthe/natphilecol.2001.html>
- Shannon, C. [1948]: A mathematical Theory of Communication, The Bell System Technical Journal, vol. 27(3), p. 379-423;
- Shannon, C., Weaver, W [1949], *The Mathematical Theory of Communication*, University of Illinois Press, Urbana, USA;
- Ubaldo, N. [2005]: *Atlante illustrato di Filosofia*, Guinti Editore S.p.A., Firenze – Milano;
- Wiener, N. [1948]: *Cybernetics or Control and Communication in the Animal and the Machine*, MIT Press, Massachusetts
- Wiener, N. [1954]: *The Human Use of Human Being: Cybernetics and Society*, Da Capo Press, 1988.
- [Wilson](#), T.D. [2002]: *The Nonsense of 'Knowledge Management'*, in: Information Research, Vol. 8 No. 1, October 2002