



Self-organization, knowledge and responsibility

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241

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Abstract

Purpose – The main purpose of this paper is to consider knowledge production as a social self-organization process, to clarify ethical implications of such an approach, and to relate it to the thinking of Heinz von Foerster.

Design/methodology/approach – The method employed is the one of dialectical constructions, i.e. existing contradicting approaches on knowledge research are identified and classified and a constructive synthesis of these approaches is made.

Findings – Since Heinz von Foerster's pioneering work, information-generating systems are considered to be self-organizing systems. We see knowledge as only a particular kind of information: it is the manifestation of information in the social realm. Thus, the creation of social information is due to the self-organization of social systems. Heinz von Foerster has given us some indications of how knowledge and self-organization could be applied to society. In this paper, we try to sketch a position of our own while taking into consideration Heinz von Foerster's relevant ideas.

Practical implications – The research results in this paper imply that a knowledge-based society can only survive if it is designed in a participatory and socially and ecologically sustainable way. Hence a practical implication is that participation and co-operation need to be advanced in order to guarantee human development.

Originality/value – The innovative aspect of the paper is that it suggests that all social self-organizing systems are knowledge-producing systems and that considering knowledge as a co-operative process implies responsibility for solving the global social problems. It combines knowledge research and systems thinking based on ideas on self-organization by Heinz von Foerster in order to describe social systems.

Keywords Knowledge management, Information, Social systems

Paper type Conceptual paper

1. Introduction

It was some 10 years ago that a member of our newly-formed research group had one of several face-to-face talks with Heinz von Foerster. The underlying assumption of the research of our group was to intrinsically link the generation of



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information to the process of self-organization. Heinz von Foerster is known to have been the first researcher to introduce the notion of self-organizing systems to the scientific community at the end of the 1950s (though at the time this notion had a somewhat different and more limited meaning). In 1960, von Foerster published the paper "On Self-Organizing Systems and its Environment", one of the first and most important works on this topic. In 1961, he organized a conference on self-organizing systems in Chicago and in 1962 he edited the conference proceedings with George Zopf (von Foerster and Zopf, 1962). Therefore, we were keen to hear his views. And at this interview he did agree: information generating systems are self-organizing systems (while the so-called self-structuring systems do not self-organize and thus do not generate information – refer Fuchs-Kittowski and Rosenthal 1998, p. 152).

This stimulated us to continue working on this basic assumption. Since we pursue the idea of second order cybernetics[1] as a general science, we wish to construct a general theory of information and self-organization that transcends interdisciplinary boundaries. In the meantime we labelled this approach "Unified Theory of Information" and tried to lay out some cornerstones for it.

The aim of this paper is to show how knowledge and self-organization are interrelated. The consideration of the interrelationship of information and self-organization is extended to the sphere of social systems. We argue that knowledge is the manifestation of information in the social realm and that social systems are manifestations of self-organizing systems in the social realm. Von Foerster was not a sociologist, but his general philosophical and cybernetic work on self-organization allows us to try to work with the concept of self-organization in the domain of sociology. In this effort we are guided by his spirit in considering science and knowledge as an open endeavour. We acknowledge Heinz von Foerster's suggestion that self-organizing systems are open systems connected to their environment and start on our own theory based on this idea.

We suggest that the study of the social environment of human beings is of great importance when we speak about knowledge and self-organization. We conclude by arguing that the knowledge-based society is a high risk society and that hence knowledge today must imply responsibility. It does not make sense any longer – and is in fact counterproductive – to claim that knowledge is value-free. Knowledge does, on the contrary, have ethical implications and implies responsibility as has been stated time and again in past centuries as well as by Heinz von Foerster.

2. Information in the perspective of self-organization

Heinz von Foerster has made important contributions to the study of self-organizing systems. He stressed that a self-organizing system is in close contact with an environment with which it is in a state of perpetual interaction (von Foerster, 1960, p. 221). For social systems this means that society and social systems are not closed systems, they require material and communicative inputs from nature and social systems. "By a self-organizing system I mean that part of a system that eats energy and order from its environment" so that the system is "increasing [...] [its] internal order" (von Foerster, 1960, p. 223). Von Foerster expresses this in terms of relative

entropy. The condition for a system to be self-organizing is:

$$\frac{\delta R}{\delta t} > 0, \quad R = 1 - \frac{H}{H_m},$$

where H is the entropy; and H_m the maximum entropy.

With time the state of order of a self-organizing system increases as its entropy decreases. When the state of order or level of organization of such a system increases, more and more relations between its elements become apparent (von Foerster, 1960, p. 224). Von Foerster argues that the two important mechanisms of self-organization are order from order and order from noise. Schrödinger introduced the notion of "order from order" as the real clue to the understanding of life. We can say that in its self-reproductive phase, a self-organizing social system is based on this principle, it steadily increases its level of order, new social structures emerge and the system expands. But at a certain threshold, quantity turns into quality; the structures of the social system fluctuate and enter a period of disorder. Social structures dissolve; the system enters a phase of crisis and disorder. Here the second principle that has been introduced by von Foerster, "order from noise", is important. From the disordered state of the system new order emerges. Order from noise means that "a self-organizing system feeds upon noise" (von Foerster, 1960, p. 227). There is both a continuous and a discontinuous form of self-organization. The first can be termed self-reproduction or autopoiesis, the second order from noise.

A self-organizing system changes its internal state in response to environmental stimuli. Emergent structural change takes place within the system; the system's components interact synergetically and produce a common result that cannot be reduced to single activities. The system establishes relations that can be categorized as informational, i.e. relations between the external trigger, the system itself and its activities (including the products of these activities). The difference in the environment does make a difference to the system (Bateson, 2000). The system changes its behaviour, state or structure by interpreting the difference and its environment by its own activity. It produces a difference within its own material foundation by establishing a relationship to an external difference.

In this respect, Heinz von Foerster's criticism of considering information and knowledge to be commodities and thus substance was pathbreaking and is still unrivalled in its severity. Information, he stated unequivocally – and in language later used by Luhmann – is not in the environment. It is a relative concept that has to relate to the activity of an observing system (von Foerster, 1982, pp. 193-4, p. 216, 237, 263). Von Foerster (1980 1999 p. 97 2002 pp. 306 341-5) has stressed that information is not a good or substance that is transported through a channel or tube. If this were the case, it would imply that sender and receiver have the same information after the communication process has taken place. What is transported would not be information, but data or signals. Shannon's theory of communication would not be an information theory, but a signal theory. Information would always involve the interpretation of data. It could not be stored in books or libraries. Such entities would only be carriers of potential information (von Foerster, 1999, p. 98). Speaking about human systems, knowledge would not be a thing that is funnelled into the head, but would require active construction (von Foerster, 2002, p. 306).

3. Social self-organization

Considering evolution as a self-organized process where new levels of organization with emergent qualities emerge in phases of instability, a hierarchy of system types can be constructed. The hierarchy starts from physical and chemical (dissipative) systems, goes up to living (autopoietic) systems and finally to social (re-creative) systems. Higher levels incorporate lower ones, they are of a higher complexity and have emergent properties.

Using Heinz von Foerster's terminology we can interpret society as a non-trivial system.

Trivial systems are predictable, independent of history and deterministic, non-trivial systems are dependent on history and to a certain extent indeterminable or unpredictable (von Foerster 1984 pp. 8-13 1991b pp. 357-60 1992a pp. 60-6 1992b pp. 143-6 1999 pp. 54-63 2002 pp. 177-9). This means that society is a complex, non-linear system. Certain stimuli of social activity do not produce under all circumstances the same outcomes, i.e. patterns of social action and relationships. It can indeed be the case that one input into the social system produces under different circumstances very different forms of action.

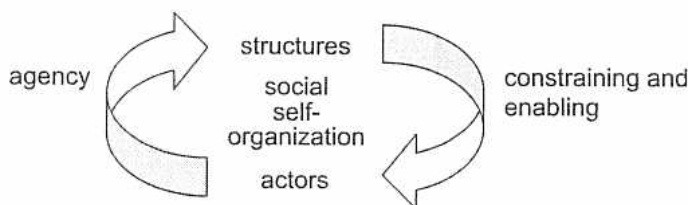
But this does not mean that a social system is fully governed by chance: there are regularized patterns of action that enable the reproduction of the system and a certain degree of predictability of certain actions. Members of the same group have a comparable habitus and therefore in a number of situations show "homologous" behaviour (for a discussion of the relationship of the concept of the habitus and of Pierre Bourdieu's social theory to concepts of self-organization refer Fuchs (2003b)).

Applying Heinz von Foerster's principle of order from noise to society means to acknowledge that the overall self-reproduction of society is not a smooth, permanently stable process: it is in constant flux and from time to time enters phases of crisis. These are periods of instability in which the further development of the overall system is not determined. In modern society, periods of crisis are caused by developing structural antagonisms. Phases of stable re-creation result in phases of instability in which the future development of the system is highly undetermined. Objective social structures condition a gamut of possibilities: it is not pre-determined which alternative will be adopted. In such phases of crisis and bifurcation, agency and human intervention play an important role in order to increase the possibility that a certain desirable alternative will be adopted. Certainty cannot be achieved nor do the principles of self-organized social change exclude agency. The whole movement of social self-organization is based on a dialectic of chance and necessity (for a discussion of the ontological aspect of indeterminism in the context of Heinz von Foerster's nontrivial machines refer Hofkirchner (2001)). It is determined that a certain social formation or mode of social development will collapse and enter a crisis, but the exact causes, the exact point of time as well as the outcome of the crisis are not determined. This means that no phase of societal development (like social formations such as feudalism or capitalism or development models such as Fordism or Postfordism) can exist for ever and that its inner contradictions at some point of time will cause the end of the system and the rise of a new system. Concerning a phase of instability in society, the historical development is relatively open, but it, nonetheless, depends on certain subjective factors, i.e. on agency and human intervention which can increase the possibility that certain paths will be taken and that others will be avoided. But there

can be no certainty, the sciences and hence also the social sciences are irrevocably confronted by the end to their alleged certainties (Wallerstein, 1997). For a long time the social sciences were dominated by a mechanistic paradigm that led many social scientists to believe that all social developments are governed by necessity and hence can be fully controlled and steered.

Societal structures exist not external to, but rather in and through human agency. In our view, the active human being is the component or element of a social system. Human activities are the foundation of social systems. By the interaction of human actors, new social qualities and structures can emerge that cannot be reduced to the individual level. This is a process of bottom-up emergence that is called agency. Emergence in this context means the appearance of at least one new systemic quality that cannot be reduced to the elements of the system. So this quality is irreducible and it is also to a certain extent unpredictable, i.e. time, form and result of the process of emergence cannot be fully forecast by taking a look at the elements and their interactions. Structures also influence individual actions and thinking. They constrain and enable actions. This is a process of top-down emergence where new individual and group properties can emerge. The whole cycle is the basic process of systemic societal self-organization that can also be called re-creation because by the permanent processes of agency and constraining/enabling a system can maintain and reproduce itself (Figure 1). It again and again creates its own unity and maintains itself. Societal structures enable and constrain actions as well as individuality and are a result of social actions (which are an emergent result of connected individualities).

Adopting Jantsch's (1979/1992), terminology we refer to the self-organization of social systems as "re-creation". Re-creation denotes that individuals that are parts of a system permanently change their environment. This enables the system to change, maintain, adapt and reproduce itself. What is important is that the term re-creation also refers to the ability of all human beings to consciously shape and create systems and structures; an ability that is based on self-consciousness and, in Giddens' (1984) terminology, the reflexive monitoring of action. Societal systems are re-creative ones because they can create a new reality: the socio-cultural human being has the ability to create the conditions for his further evolution independently. Creativity means the ability to create something new that seems desirable and helps to achieve defined goals: it is a central feature of communicative action. The common productive process of re-creation describes the reflexive, self-referential nature of society in which structures are both a medium for and the outcome of social actions (Giddens, 1984, p. 25, for the relationship to Giddens' theory of structuration and social self-organization refer Fuchs (2003c).



Note: This model of social self-organisation was first introduced by Hofkirchner (1998) and elaborated in a number of further works such as Fuchs (2003a, c)

Figure 1.
Self-organization in social
systems

There are two types of re-creation: the integrative, reproductive one and the disintegrative, discontinuous one (Bourdieu 1986, p. 165). They do not exist independently because it is determined that every social formation and mode of development enters a phase of instability. It is, however, uncertain when this will be the case and what the exact reason and the outcome will be. We find both continuity and discontinuity in society. Social systems are historical systems (Wallerstein, 1974): they have a beginning and an end, as well as re-creative dynamics in-between.

The basic process of self-organization, which is shown in Figure 1, takes place in a number of subsystems of society. We have identified five of these. In the technosphere human beings make use of tools as a means of achieving defined goals by transforming nature. The structures that are both medium and outcome of human agency are here technological artefacts. In the ecosphere human beings transform nature in order to allow it to organize natural resources in such a way that it may utilize these resources for its needs and goals. Here the structures that are both medium and outcome of human agency are the natural resources. In the economic system human beings make use of tools and natural resources in order to produce, distribute, allocate and consume use-values that satisfy human needs. Here the structures that are both medium and outcome of human agency are economic property. In the political system human beings establish power structures in order to make collective decisions. Here the structure that is both medium and outcome of human agency is the power to make political decisions, i.e. social rules. In the cultural system human beings produce a set of norms and values that define living conditions and life-styles. Here the structures that are both medium and outcome of human agency are definitions, collective norms, values, morals and ethics. These five basic cycles of social self-organization constitute five interconnected subsystems of society. The structures in these subsystems are manifestations of objective social information. Each time we act in a social system, all five dimensions are present at the same time, i.e. we are confronted with technological/scientific knowledge, ecological knowledge, economic knowledge, political knowledge and cultural knowledge. Nonetheless it is possible to distinguish, e.g. economic from political institutions: in the first dimension economic knowledge is the dominant structure that is produced because it mediates agency whereas in the latter political knowledge is the dominant structure. Nonetheless, all five forms of objective social knowledge are present and important in all social institutions.

The five basic cycles of social self-organization that we have outlined can also be summed up in a general model of systemic social self-organization that consists of three self-organizing loops (Figure 2, Fuchs, 2002; Fuchs *et al.* (n.d.)).

4. Knowledge

Given this conception of social self-organization as a productive mutual relationship between social structures and social actors, it can be argued that knowledge is a constitutive aspect of all social self-organization and involves both subjective and objective aspects. Knowledge is neither purely a subjective or individual cognitive attribute nor purely an objective, societal or ideational entity. It is a process and relationship between active human agents who participate in a self-organizing social system and co-ordinate their subjective, individual knowledge in such a way that objective, societal knowledge emerges.

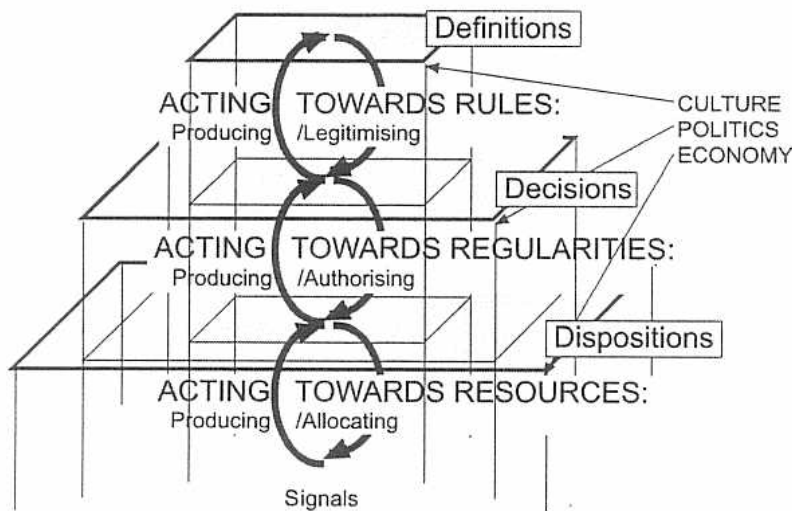


Figure 2.
The re-creation of society
as a whole

We do not use the term “objective” in the sense of “absolute”. By saying that social knowledge is objective and individual knowledge subjective we mean that individuals are actors who enter into social relationships (they act as subjects in these relationships) where they are confronted with the ideas and actions of other subjects whom they address with their ideas and actions. Hence each individual in a social relationship is a subject which addresses other human beings as objects of action and at the same time an object that is being addressed by the actions of other human subjects. Hence the term “objective” refers rather to the form and structure of society than to the content and truth of ideas. “Objectivity” in this context does not refer to the question of truth. It refers only to the supra-individual level where knowledge may legitimately be studied as it may on the individual level.

We consider knowledge to be a threefold process of cognition, communication and co-operation. Cognition, communication and co-operation refer to different system dimensions of social information processes. The first, cognition, refers to the individual dimension, that is, to the elements of social systems; the second, communication, to the interactional dimension, that is, to the interaction of individuals as elements of social systems; the third, co-operation, to the integrational dimension, that is, to the social system itself that is constituted by the interaction of its elements.

When two human systems interact (Figure 3), they enter an objective relationship, i.e. a (mutual) causal relationship is established. Subjective, systemic knowledge (*cognition*) is communicated from system A to system B (and vice versa, *communication*). The cognitive structural patterns that are stored in neural networks within the brains of individual human agents can be termed subjective knowledge. Subjective knowledge refers to the cognitive structure of individual human beings that enables them to act. Human actors are knowledgeable beings. Communicating knowledge from one system to another causes structural changes in the receiving system. If there is a knowledge relationship between the two systems, it is determined that there will be causal interactions and structural effects. The structure of the systems (structural, subjective knowledge) changes, but we do not know to what

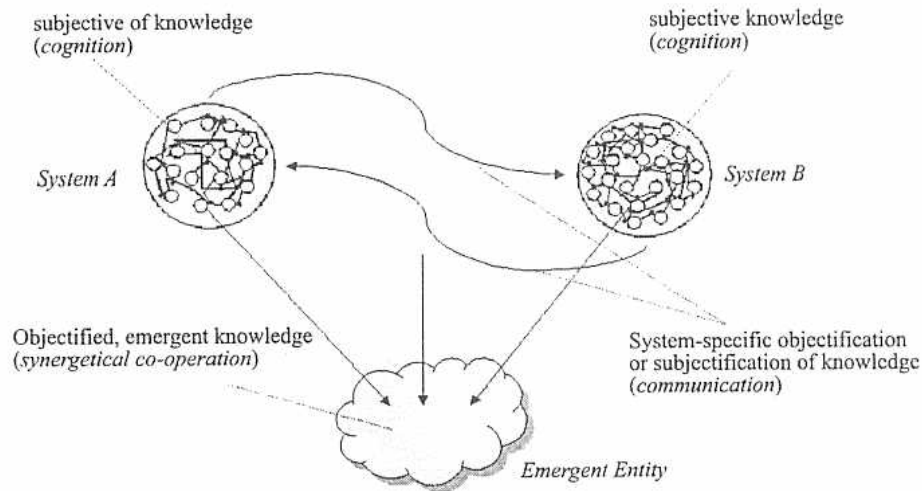


Figure 3.
A model of knowledge as a threefold process of cognition, communication and co-operation in social systems

extent this will actually occur, or which new subjective knowledge will emerge, or how knowledge structures will be changed, etc. There are degrees of autonomy and freedom (= chance). If structural changes in system B take place that are initiated by system A and if, in turn, as always happens with communication processes, structural changes occur in system A that are initiated by system B; there is a convergence of the subjective knowledge from A and B which may be termed "intersubjectification". Intersubjectification means that from the point of view of each of the communicating partners the knowledge of the ego becomes, so to say, objectified in the knowledge of the alter ego and, reciprocally, the knowledge of the alter ego becomes, so to say, subjectified in the knowledge of the ego. Objectification and subjectification of knowledge in this context takes place only on the level of different individuals. We want to stress again that objective here means a structural change inside a system that is caused by the system's environment; i.e. outside factors trigger change, they are embedded into the system's structure by triggering activity in the system that results in structural differentiation of the same. Communication, however, may not only lead to an objectification of knowledge in some of the systems involved, but due to the synergies between the systems new qualities (knowledge) may emerge in their shared environment (*co-operation*). Structural, subjective knowledge of the involved systems is co-ordinated, synergies are realized and thus they jointly produce something new in a self-organization process. The new structure or system that arises is an objectification of the (or parts of the) subjective knowledge of the involved systems that has emergent qualities. Subjective knowledge refers to interpreted and evaluated sense-data of a single human being. Knowledge in self-organizing social systems has cognitive (subjective), communicative (intersubjective; new subjective knowledge [=cognitive structures] emerges in systems due to interaction) and co-operative aspects (objective; interaction results in synergies that cause the emergence of new, objectified knowledge in the shared environment of the involved systems).

Social self-organization is based on cognition, communication and co-operation as three aspects of knowledge. When a social system organizes itself, it starts from the

cognitive knowledge of the actors involved. By communicating these actors co-ordinate their subjective knowledge and cause their respective knowledge to change in respect to their capacity to act successfully. This communication can result in co-operative processes, i.e. in the co-ordination of activities which produces the emergent qualities of the social systems. These emergent results are produced by synergies that arise from the interaction of the agents and the co-ordination of their subjective knowledge; emergent qualities of a social system are an objectification of the knowledge of the involved actors and the co-operative dimension that arises from their communication. There can be no social self-organization and no social system without subjective knowledge because all social activity is based on active, knowledgeable human actors. That is why purely objective concepts of knowledge that consider knowledge as a thing and as being independent of human beings are insufficient. And there can be no social self-organization and no social system without objective knowledge because artefacts and social structures that store knowledge about the system are the foundation of all organizations. That is why purely subjective concepts of knowledge are insufficient. An integrated notion of social self-organization is based on both subjective and objective aspects of knowledge; it is based on a dialectic of subjectivity and objectivity. Subjective knowledge results in and is based on objective knowledge. Objective knowledge results in and is based on subjective knowledge.

A human individual has a specific cognitive structure which is influenced by social structures and by the social relationships it enters into and with which it influences processes of agency. In social systems individual values, norms, conclusions, rules, opinions, ideas and beliefs can be seen as individual knowledge. Why do we speak of individual or subjective knowledge although it is clear that an individual is always a social being? Each individual is a unique character which has a specific cognitive structure. Individual/subjective knowledge refers to the individual as a living and psychological system. Individual actors are the components of social systems; individual knowledge describes aspects of knowledge generation within these movements. This process is always influenced by society and the social relationships the individual enters into, but it is never determined by them. Thus we find, e.g. socially accepted norms, rules and values in society which influence individual thinking and actions to a certain degree. But it cannot be concluded that all individuals necessarily share these social norms and rules because they are creative and self-conscious beings who have a certain degree of freedom of action and thinking. How much freedom it is depends on the degree of participation and democracy in the existing social structures. Social and individual norms, values and rules cannot simply be mapped linearly; there is a complex relationship between individual thought and social conditions. This complexity also justifies the term individual/subjective knowledge because it takes into account that individuals have unique and complex cognitive structures.

We find different processes of self-organization within the human mind and body. This results in the emergence of subjective knowledge. Cognition is always bound up with the outside world: a subject relates itself to events and states of its environment. The subjective knowledge process can be described as layered; levels of higher and lower quality can be distinguished. A transformation of subjective knowledge from lower to higher levels takes place. This layered cognitive self-organization process can be summarized (Figure 4, for details cf. Hofkirchner, 1999): on the first level signals

from the environments are perceived and transformed into data; on the second data are interpreted, knowledge emerges as interpreted data; on the third knowledge is evaluated, it gains a practical dimension that is oriented on problem-solving, it is transformed into codes of practice. Data are stimuli that are perceived in the environment, but they are not a form of knowledge. Subjective knowledge is formed on the second level only. It always involves interpretation.

We argue that knowledge has both subjective and objective aspects. A purely subjective theory of knowledge is as one-sided as a purely objective one. They have to be combined in order to establish a multi-faceted theory of knowledge. Knowledge is as remote from pure subjective construction as it is from pure objective representation. We argue in favour of both modest constructivism and modest realism, of realistic constructivism, as it were, in which knowledge is a constructive reflection and construction is mental, social and material production. Subjectivists tend to argue that knowledge is tied to cognition, that it does in no way exist independently of an observer in the outside world. They do not take into account that knowledge that is materialized in technologies, artefacts and collective social organizations is an expression of the expertise, experience, practice, meaning, etc. of active human beings who enter social relationships where they jointly produce knowledge products. Hence knowledge is indeed objectified/materialized both in artefacts and in social organizations. In these it gains objective existence. Objectivists, on the other hand, tend to argue that knowledge exists in artefacts independently of human actors. But knowledge as a social relationship is never independent of human individuals, it is intrinsically linked to their thinking and social practice. If society were independent of individuals, it would mean that social structures determine the thinking and actions of every individual purely mechanically. Hence a certain degree of freedom of action would be impossible, all thinking and action would be predetermined. Social relationships are based on individual thinking and action, on routine and the conditioned freedom of action of the individual. There is a certain degree of spontaneity in society and this phenomenon is due to the fact that human beings are self-conscious beings who can decide how to act and how not to act.

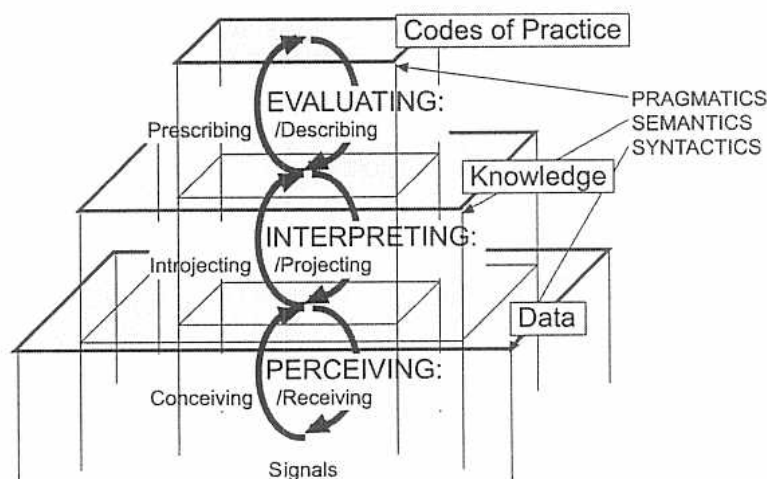


Figure 4.
The generation and differentiation of individual/subjective knowledge

Can an old book that is kept in the magazine of a library and that is no longer of interest to anyone be considered to be knowledge? A subjectivist would answer: "No", because she quite properly would point out that it is practically not in use, nor cognitively interpreted by anyone. An objectivist would answer: "Yes", because he would reasonably maintain that there is data stored in a material substance. The answer we propose is that

It is objective knowledge as a result of past human practice; it stores facts about past experience. It is objective knowledge as an artefact that is embedded into existing social practices and institutions (running the institution library). But it is not part of our subjective knowledge in the form of real practical experience and the current interpretation of active human beings.

Objective knowledge can be analytically separated from subjective knowledge, but it is linked to past and present social agency. It is not independent of human experience, but also not determined by purely individual subjective processes. Knowledge is a process which has cognitive, social and material dimensions. Knowledge artefacts and organizations are an externalized, objectified form of knowledge existing outside of the cognitive dimension of a human being, but they are not independent of past and present human experience. Technologies like software, computers, computer games, hardware, mobile phones, digital cameras, etc. store intelligence: they are embedded intelligence; it is not necessary to understand the intelligence that is embedded in technologies in order to make use of it.

Structures are totalities of durable and institutionalized behaviour. They can be found in all subsystems of society. Structures mediate communications and actions; they are both medium and outcome of actions and communications. Structures are social relationships and objective knowledge in society. Social knowledge is a communicative relationship between actors where artefacts are included in order to produce sense and achieve goals. Knowledge, as an organized form of data that are interpreted, assessed and compared, is contained in artefacts and social relationships. Artefacts store dead labour and knowledge about society. Collective social actors (organizations) are an expression of durable human connectivity; they are shared living and working space and incorporate both interacting human actors and their artefacts. Social structures are media of society because they mediate social actions and communications. They store and fix knowledge and hence they simplify actions and communication because the foundations of these processes do not have to be produced permanently, they can be achieved by making use of structures. Hence by storing knowledge, social structures reduce social complexity. Structures are carriers of knowledge; they are the foundation of temporal and spatial extension of social systems. Social structures make possible a continuity of social reproduction across space and time; they result in the temporal and spatial distancing of social relationships without the loss of continuity. Structures also produce specific forms of contiguousness and hence they dissolve distances by reembedding social relationships that are disembedded in space-time. Social structures are a basis for action and communication; they enable a certain degree of mobility; they mediate, organise, and co-ordinate social relationships and communications.

Social structures store knowledge about society. In re-creative, i.e. social systems, self-organisation produces what can be termed objective social knowledge: the word "social" in the term means that such a form of knowledge is constituted in the course of

social relationships of several human actors. We consider the scientific-technological infrastructure, the system of life-support elements in the natural environment and all else that makes sense in a society, i.e. economic property, political decision power and the body of cultural knowledge, norms and values to be objective social knowledge. So we can distinguish five different types of objective social knowledge: ecological knowledge, technological knowledge, economic knowledge, political knowledge and cultural knowledge. These forms store knowledge about past social actions and simplify future social situations because by referring to social knowledge the basics of acting socially do not have to be formed in every such situation. Objective social knowledge can be seen as a durable foundation of social actions that nonetheless changes dynamically. Tools, natural resources, property, decision power and definitions are manifestations of objective knowledge.

In the social self-organization processes that are based on mutual productive relationships between structures and actors, knowledge is an essential feature because social self-organization is based on existing social structures, i.e. objective knowledge and existing cognitive structures, i.e. subjective knowledge, and in a threefold process of cognition, communication and co-operation, it produces both new subjective and new objective knowledge. Hence the basic cycle of social self-organization can also be described as a dialectical interconnection of subjective and objective knowledge. This cycle of self-organization/re-creation results in the bottom-up emergence of objective knowledge and the top-down emergence of subjective knowledge. Objective social knowledge (tools, resources, property, decision power, definitions) are both medium and outcome of subjective knowledge: in processes of communication and co-operation human actors co-ordinate their subjective knowledge in such a way that objective knowledge structures emerge; these structures are a basis for further cognition, actions, communication and co-operation; they enable and constrain social phenomena. So the dialectic of structure and action, which is at the heart of social self-organisation/re-creation, can, on the informational level, also be described as a dialectic of subjective and objective knowledge: a social system organizes itself permanently in order to maintain itself and it permanently produces and changes objective and subjective knowledge. As shown in Figure 5 this is a dialectical process: objective social knowledge emerges from subjective knowledge. The subjects of society create and change social systems by relating their actions and hence their consciousness. New patterns emerge from this process. On the other hand, we have a process of dominance: individual consciousness can only exist on the basis of social processes and objective knowledge. Social knowledge restricts and enables individual consciousness and action. In this dialectical relationship of subjective and objective knowledge, we have the bottom-up-emergence of objective social knowledge and the



Figure 5.
The informational aspect
of the re-creation of social
systems

top-down-emergence of subjective individual knowledge. On the macroscopic level of the social system, new objective social knowledge can emerge during the permanent self-organization/re-creation of the system. On the microscopic level, objective knowledge makes an effect in a process of domination and new subjective individual knowledge can emerge. The endless movement of subjective and objective knowledge, i.e. the permanent emergence of new knowledge in the system, is a two-fold dialectical process of self-organization that consists of an upward causation and a downward causation and makes it possible for a social system to maintain and reproduce itself.

We want to summarize some important basic characteristics of knowledge:

- Knowledge is a manifestation of information in the human-social realm. Knowledge does not exist in nature as such; it is a human and cultural product.
- Knowledge exists both in the human brain and in social structures and artefacts. It has subjective and objective aspects that are mutually connected. Subjective and objective knowledge is constituted in social practices of active, knowledgeable human beings; knowledge is related to human practice. Hence the main question of a sociology of knowledge is according to Karl Mannheim: "What categories, what systematic conceptions are used by the different groups at a given stage in accounting for one and the same fact uncovered in the course of practical operations? And what are the tensions which arise in the attempt to fit these new facts into those categories and systematic conceptions" (Mannheim, 1952, p. 147).
- Objective knowledge is stored in structures and enables time-space distanciation of social relationships. To say that social structures "store" knowledge means that they tell us something about the history of society and contain a history of social relationships that enables future social relationships. It reduces the complexity of social systems; foundations of human existence do not have to be re-produced permanently due to its storage-function. Such storage mechanism of social knowledge includes rules, resources, technologies, property, decision power, norms, values, traditions, myths, world views, codes, routines, guidelines, databases, organizations and institutions. Objective knowledge is a supra-individual structural entity (Willke, 2001; Argyris and Schön, 1999; Etzioni, 1971; Sveiby, 1997), but it is based on human agency, it is both medium and outcome of social actions and it constrains and enables human practices.
- Individually acquired knowledge can be put to use efficiently by entering a social co-ordination and co-operation process. Synergetical advantages that could not be achieved on an individual basis can be gained by such a co-ordination of knowledge. Emergent knowledge and qualities appear and are due to the synergies produced by the co-operating efforts of knowledgeable actors. Intelligent organizations are based on the effective use and management of emergent knowledge.

5. Knowledge and responsibility

All societies are based on human activity which produces subjective and objective knowledge. But nonetheless we do not characterize all types of societies as "knowledge-based societies" (KBS). This term is reserved to characterize a social formation that is shaped by a specific type of knowledge, scientific and technological

knowledge in all its forms. The emergence of the knowledge-based society is a multidimensional shift that involves the rise of knowledge as a strategic resource in all social fields. All human labour is based on a dialectical interconnection of mind and body. Hence all labour are both mental labour and manual labour. But nonetheless a distinction between mental labour and manual labour can be made: the first is mainly based on cognition, reflection, logical operations, etc. the second on the human production of physical energy. Knowledge in the sense of the cognitive foundation of mental labour (subjective knowledge) and the products of mental labour (objective knowledge) has just as physical labour, capital and power become a defining characteristic and mechanism of modern society. This manifests itself, e.g. in a boom of service and knowledge industries, an increasing importance of innovation, universities, expertise, research, knowledge work and knowledge products. The first phase of capitalist development was based on extensive technological development; the quantity of technology, labour and capital invested in the production process was steadily increased, but technological change was quite slow. Knowledge-based capitalism experiences an intensive technological development that is based on a series of rapid technological innovations of high quality.

Just as letters, books, television, radio, telephone, telefax, telegraph, etc. the computer is a knowledge-based technology or medium. A particular feature of the computer is that it enables the convergence of traditional media in a single digital medium: knowledge-representation in the computer can combine written text, spoken words, audio, video and animations in one medium. This can be achieved by the digitization of the represented knowledge. The computer enables many-to-many communication; it is an interactive medium that allows new forms of co-operation and relationships across spatio-temporal distances. In respect to interactivity the computer differs from traditional media. Heinz von Foerster noted in this context that the traditional mass media are one-dimensional, they talk, but no one can respond: a feedback channel is missing (von Foerster, 1972, p. 172). Traditional machines as well as the new computer are an objectification of human knowledge; their technological structure is based on human knowledge produced by science. Manual labour and raw materials are the input of traditional machines such as the assembly line; their output, the product of a transformation process, consists of goods that are an objectification of manual labour. The input of a computer is mental labour that is transformed by binary operations; its output consists of knowledge products that are an objectification of mental labour.

Computer usage has resulted in a real time globalization of social relationships; knowledge flows today transcend national borders; they result in a globalization, intensification, time-space-distanciation of social relationships and establish a more intensive and extensive interconnection among human beings, a sort of supraterritoriality, time-space compression, action at a distance and accelerating interdependence (Giddens, 1990; Harvey, 1990; Held *et al.*, 1999; Robertson, 1992; Scholte, 1999). Knowledge is today quite substantially detached from territorial space; it cannot be confined to a fixed and limited territorial location; it operates largely without regard to territorial distance: it transcends territorial space. New knowledge-based technologies like the computer facilitate the de-localisation and disembedding of economic communication: they generate spatial and temporal distance. One of the main characteristics of knowledge-based technologies is that they

increase the speed of delivery of data massively: they are the medium of the time-space distancing of communication. They contribute to the disembedding and delocalization of social systems and relationships and hence reshape society. But they also further the reembedding and localization of disembedded social relationships, e.g. the globally available information on the Internet is embedded into the local cultural contexts of action by the recipients.

The 20th century has seen an unprecedented increase in the intensity, extensity and velocity of global communication that is closely related to the advent of radio, television, satellite transmissions, the microelectronic revolution and digital fibre-optic cable networks/digital data processing. The transatlantic cable of 1866 reduced the time of transmission of information between London and New York by over a week; the telephone increased the velocity of messages by a few minutes; the Internet reduced it hardly at all in comparison to the telephone (Keohane and Nye, 2000, p. 80). This does not imply that technological globalization is a myth, but that we should also take note of qualitative aspects such as the reduction of the costs of information transport and new qualities of communication such as many-to-many-communication, interactivity, hyperlinking, multimedia, conversion, simulated virtual realities, the decontextualisation and dereliction of communication, the implications of computer mediated communication for the formation of identities, etc.

The common theme underlying Giddens' (1990) concept of disembedding Castells' (1989 1996 1997 1998 2001), concepts of timeless time and spaceless space and Harvey's (1990) concept of time-space compression is that modern society requires new technologies and forms of organization that accelerate production and make it more flexible in order to function. Hence the history of capitalism is a history of globalization and the technological acceleration of transportation (of data, capital, commodities and people). This makes the world a smaller place in the sense that it increasingly mediates social relationships more efficiently so that distances seem to be disappearing. Technological progress has resulted in an increasing cleavage between the movement of information and that of its human bearers; the movement of information gathered speed at a much faster pace than that of travelling bodies (Bauman, 1998, p. 14). Bauman is right in emphasising that this is a stratifying form of mobility where unprecedented freedom from physical obstacles and the ability to act at a distance can only be enjoyed by some.

Today we live in knowledge-based society in the sense that knowledge and knowledge-based technologies have become immediate forces of production that influence and change all subsystems of society. The increased knowledge-based character of society is due to the rising importance of expertise, scientific knowledge and knowledge-based technologies.

Globalization and informatization are inherently linked; this relationship calls forth antagonistic relationships in all subsystems of society (Fuchs, 2003d). The antagonisms are an expression of the fact that with the increased knowledge-based character of society, there is an increase in both fragility and problem-solving capacities. Today knowledge along with capital, power and labour is a constitutive structuring factor of society. Globalization and informatization increase the number and scope of choices for action as well as the number and scope of social risks. The knowledge-based society is confronted by a set of social antagonisms: a technological antagonism between the computer as a controlling megamachine and

a liberating alliance technology; an ecological antagonism between knowledge-based technology supporting ecological sustainability and ecological degradation; an economic antagonism between knowledge as open source and commodity; a political antagonism between e-democracy and big brother; and a cultural antagonism between global cultural wisdom and global cultural manipulation facilitated by the Internet (Fuchs and Hofkirchner, 2003a, b; Fuchs 2003d).

By entering the knowledge age, we face both great opportunities and risks. Hence the knowledge-based society requires an ethical dimension of knowledge; ethical knowledge should be developed in order to provide guidelines to actions that show which paths of development are desirable and which ones should be avoided. Social development cannot be steered because society is a complex, self-organizing system, but this does not mean that we are facing all-determining social structures that cannot be shaped. Human agency can increase the chances that certain developments will and others will not be realized. The fact that the future is only conditioned by the past and not determined in advance and that there is a great deal of uncertainty in social development shows that human agency and intervention are important because they can make a decisive difference. The governing principles of a sustainable and participatory society seem to be co-operation, self-determination and inclusion (Fuchs, 2003a). The main task of the KBS is to solve our global social problems. In a KBS that is dominated by competition, heteronomy and exclusion, these problems will not be solved. Hence ethical knowledge for the knowledge-based society should advance co-operation as a social guideline of action in all realms of society.

Knowledge creates non-knowledge, in the KBS this dynamic is of special importance because scientific-technological progress results in a number of unpredictable uncertainties of development, i.e. modernization risks. These risks threaten to get out of control. Helmut Willke speaks in this context of a crisis of knowledge (Willke, 2002). The increased influence of scientific-technological knowledge on our lives has resulted in an increased fragility of society and nature (Stehr, 1994). Risks arise as side-effects of a form of modernization that is "blind and deaf to [. . .] [its] own effects and threats" (Beck, 1994a, p. 6); the KBS is a high risk society. Ulrich Beck argues that side-effects of modernization like the destructive power of modern technologies and environmental degradation are an expression of non-knowledge. Non-knowledge would be the medium of reflexive modernization (Beck, 1994b, 1996). The more modern a society, the more knowledge-based and risk-intensive it would become (Beck, 1996). There would be two forms of non-knowledge: something that one does not want to know (Nicht-Wissen-Wollen) and something that one cannot know (Nicht-Wissen-Können) (Beck, 1996, pp. 300, 302). Further dimensions of non-knowledge would be selective reception and distribution, uncertainty of knowledge and mistakes/errors. All decisions in late modern society would be confronted with uncertainty – even expert knowledge. But to a certain extent one could try to manage risks by reflecting on non-knowledge, learning to know what one can and what one cannot know and avoiding not wanting to know (Beck, 1996, p. 309). Knowledge would be dependent on modernization risks. Many of the new dangers would not be immediately visible (e.g. radioactivity). To become visible the perceptive organs of science would be needed to produce knowledge about risks. "In this way threat situations create social dependencies of information and knowledge" (Beck, 1999, p. 266). Only through external knowledge could one become

aware of the threats one is facing (e.g. that your daily cup of tea contains DDT) (Beck, 1999). Those who are affected by risks lose a significant proportion of control over knowledge and information, they are dependent on the knowledge of others, but thereby also on the non-knowledge and mistakes of experts (Beck (1999). Beck argues that there is no scientific monopoly on knowledge about risks because science and technology would themselves produce a great deal of risks. The risk society would demand a reorganization of power and responsibility towards a participatory democracy that includes public risk awareness and consciousness (Beck, 1999). Indeed the emergence of the KBS as a high risk society has brought about the formation of a certain degree of consciousness about the risks immanent in the KBS. This awareness manifests itself in new social movements that have a democratic potential.

von Foerster (1972) has pointed out that knowledge (in German *Wissen*) requires conscience (in German *Gewissen*). On the one hand this can mean that the person or group producing and using knowledge is responsible for the social consequences of this knowledge or on the other hand that there is a specific collective responsibility of human beings to produce certain (sustainable) forms of knowledge and not to produce certain other (destructive) forms of knowledge. We understand the relationship of knowledge and responsibility both in individual and social terms.

This would be a very urgent matter because society is facing possible collapse.

Knowledge means responsibility. We can no longer afford to watch a global catastrophe as knowledgeable onlookers. We must share all the knowledge we have by communication and co-operation in order to tackle the problems of our time (von Foerster, 1972, p. 173)."

This is an indication that ethical knowledge is a fundamental foundation of a sustainable and participatory knowledge-based society.

The need to strengthen self-determination, co-operation, inclusion and participation in society can be derived from the ethical implications of Heinz von Foerster's theory. He argues that in order to exist and construct social reality, human beings depend on each other. They would construct social reality together in a joint process. There is mutual dependency (von Foerster, 1991a, p. 66, 1991b). Hence dialogue would be a central ethical principle. "It needs two to Tango [...] [and] it needs two to Language" (von Foerster, 1991a, p. 78). As did Martin Buber, Foerster speaks in this context of "two-getherness". A human being would exist through another human being and vice-versa, hence the knowledge about the other would imply conscience (von Foerster, 1992a, p. 85). Human beings would bear responsibility for the world because they construct it (von Foerster, 1999, p. 28). Reality would mean community and hence an ethical imperative could be derived: "Act always so as to increase the number of choices" (von Foerster, 1973, p. 381; 1984, p. 3, 1991a, p. 78, 1999, pp. 36-38). Communication would imply that consciousness is only possible through common knowledge, identification with the other. It would be based on seeing oneself through the eyes of the other (von Foerster, 1980, p. 280, 1991b). Social self-organization implies that "we stipulate a world where the actor acts ultimately on himself, for he is included in his organization" and a heterarchy where "each participant is also a manager of this system" and that is opposed to the top-down-organization of a hierarchy" (von Foerster 1984, 6 + 8). Autonomy would be an important principle in society; it would imply responsibility (von Foerster, 1979).

Strengthening the co-operative character of society can indeed be an ethical imperative for survival and for realizing the potentials that are immanent in the knowledge-based society. A co-operative and participatory knowledge-based society might develop into a wise knowledge-based society that can solve our global problems.

Note

1. Whereas first order cybernetics mainly focused on mechanistic control systems (mainly technological systems), second order cybernetics concentrates on rather open non-mechanistic systems that have a certain degree of chance development and indeterminism, and are self-organizing and self-referential systems.

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