Knowledge and Society from the Perspective of the Unified Theory of Information (UTI) Approach

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Abstract
The Unified Theory of Information (UTI) approach conceives information as a threefold dynamic process of cognition, communication, and co-operation. Information-producing systems are self-organizing systems. Applying this idea to society can best be done by conceiving the interactions and dynamics of social systems as mutual production processes of social structures and social practices. All subsystems of society such as economy, polity, culture, art, and science are based on information and self-organization processes. Knowledge is the social manifestation of information. We live in a knowledge society insofar as all social systems are knowledge-generating systems. Modern society today has become knowledge-based because our social systems are increasingly based on technological and scientific knowledge and on mental labour.

Keywords:
Information, society, knowledge society, information society, social self-organization, social system

1. Introduction

The aim of this paper is to point out the relationship of knowledge and self-organization. We argue that knowledge is a manifestation of information in the social realm, it is neither a cognitive entity, nor a material thing, but a reflective threefold social process of cognition, communication, and co-operation. We conceptualize knowledge within the framework of a general theory of information we call the Unified Theory of Information approach (chapter 2), distinguish between subjectivistic and objectivistic approaches on knowledge (chapter 3), point out the relationship between knowledge and self-organization (chapter 4), and conclude by showing that knowledge in the knowledge-based society has ethical implications and implies responsibility (chapter 5).
Questions that this paper deals with are: What is knowledge? What role does knowledge play in complex systems? How can knowledge be conceived as dynamic process? What is the knowledge-based society? How is the knowledge-based society related to ethical aspects?
Hence this paper focuses on three interconnected topics: knowledge, knowledge-based society, ethics of the knowledge-based society (KBS). It is insufficient to treat any of these topics separately because the concept of the KBS is based on the concept of knowledge and both the concepts of knowledge and the KBS have ethical implications because knowledge is a social construct and if it is embedded in social relationships and a product of such relationships then the question arises how these relationships should be shaped and how knowledge should best be constructed in order to satisfy human needs and to advance the well-being of society and its individuals. The social character of knowledge implies the responsible co-construction of knowledge, all social relationships have ethical implications because they are a co-ordination of the values and knowledge of individuals and hence one must ask the question how such a co-ordination can best be achieved.
There is much talk about knowledge and the knowledge society. E.g. the strategic goal of the European Union for 2010 that has been set at the Lisbon European Council in March 2000 is to “become the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion”. There seems to be an increasing importance of knowledge, but a lack of understanding knowledge and its dynamics. In this paper we suggest that a general theory of self-organization is an adequate framework for establishing a broad understanding of knowledge. Knowledge is a social relationship in self-organizing social systems. It should be conceived within the framework of a Unified Theory of Information.
I will identify different approaches on knowledge (section 2) which will function as a foundation for the a dynamical concept of knowledge (section 3). Finally I will outline some aspects of the knowledge society and its ethical implications (section 4).

2. Subjectivistic, Objectivistic, and Dualistic Approaches on Knowledge

The notion of knowledge has a long philosophical history. Plato distinguished two types of knowledge: doxa and episteme, mere belief and true belief. The Sophists questioned the objective character of knowledge and stressed the active, creative role of the human subject. The distinction between practical and absolute aspects of knowledge can be found in Aristotle’s concepts of phronesis (cleverness) and sophia (wisdom). Rationalism postulated the existence of truth and ideas a priori to experience, Empiricism argued that ideas are constituted only through experience and hence can change and are not absolute. Kant tried to synthesize Rationalism and Empiricism by arguing that the source of knowledge is both reason (understanding, conception) and experience (sensibility, perception). Hence the distinction between objective and subjective knowledge is a classical philosophical one that still shapes science and scientific conflicts (e.g. between realists and constructivists) today. One dominant approach on knowledge research is close to the Rationalistic tradition, the other close to the Empiricist tradition.

We consider knowledge as the manifestation of information in social systems that involves the interpretation, evaluation, and usage of data and can be found in various subsystems of society. It is a social relationship between active, knowledgeable, self-conscious human agents. Talking about knowledge means talking about the most complex organizational level in the evolutionary world process that we are aware of – society. Traditionally, knowledge has been conceived either as purely subjective or as purely objective. Seeing knowledge as a productive social relationships that takes place in self-organizing social systems helps to avoid such one-sidedness and integrates a dialectic of subjectivity and objectivity into the concept of knowledge. We first want to discuss subjectivistic and objectivistic approaches of knowledge in order to show how our own concept differs from these ones and tries to bridge the gaps between them (cf. the typology of knowledge concepts in tab. 1). Subjective theories conceive knowledge as opinion or belief, a state of mind, objective theories consider it as symbolic content stored in objects of the human being's environment, dualistic theories consider it as having independent subjective and objective forms. The decisive criterion for the typology in tab. 1 is the relationship between subject and object that can be conceived as reductionistic, holistic, dualistic, or dialectical.

Type of Approach	**Knowledge conceived as…**
Subjectivistic (individualistic) approaches	cognitively constructed domain (*knowledge as cognitive attribute)*
Objectivistic approaches	material structural artefact or an organization that exists outside of human subjects (*knowledge as material thing or collective organization*)
Dualistic approaches	two independently existing forms: 1. a cognitively constructed domain, 2. a material structural artefact or a collective organization *(knowledge as two independent subjective and objective domains)*
Dialectical approaches	process of cognition, communication, and co-operation that has both subjective and objective aspects (*knowledge as process and reflective relationship*)

Tab. 1: Typology of approaches on knowledge research

2.1. Subjectivistic Approaches

A classical distinction is the one between "knowing that" and "knowing how" [76] which has also been conceived as difference between declarative (fact-based, static) knowledge and procedural (dynamic) knowledge (Baumgartner 1993). Michael Polanyi [71] distinguished between implicit/tacit (based on experiences, learning) and explicit/focal (formalised, documented) knowledge, arguing that "we know more than we know how to say" [71: p. 12]. Recently it has been suggested to add visual knowledge (in three forms of directly perceived knowledge, retrospective knowledge, and imaginative knowledge) to the distinction between implicit and explicit knowledge [73].

Karl Mannheim [60], besides Max Scheler the most important representative of the classical sociology of knowledge, argued that all thinking of a social group is determined by its existence. Both knowledge and existence would be evolving. For Mannheim knowledge means intellectual standpoints and facts constituting cognitive reality. “The attainment of new knowledge consists in incorporating new facts into the old framework of definitions and categories, and ascertaining their place therein” [60: p. 148].

Emile Durkheim has conceived knowledge in his sociology as “the fundamental ideas of the mind, the essential categories of thought” [19: p. 259]. Robert Merton considered knowledge as “mental production”, as “every type of idea and every mode of thought” [65: p. 521]. He interpreted ideas, ideologies, juristic and ethical beliefs, philosophy, science, and technology, as such ideal products [65: p. 510ff].

Another subjectivist concept of knowledge has been put forward by Michel Foucault [22]. For him knowledge is the content and product of a discursive practice, a set of elements constituted regularly by a discursive practice that is necessary for the constitution of a science. Knowledge would be the subject-matter of a discursive practice (“that of which one can speak in a discursive practice”). There would be no knowledge without defining a discursive practice, each such practice could be defined by the knowledge by which it is formed.

Alfred Schütz [80] has argued that knowledge is socially distributed according to ideal types of knowledge construction (the man on the street, the citizen who aims at being well-informed, and the expert). He suggests that the sources of socially-acquired knowledge can be seen as four ideal types: knowledge of the eyewitness, the insider, the analyst, and the commentator.

Niklas Luhmann [56] argues that knowledge is a structure that enables the autopoiesis of communication, it would guide how one communication produces another one and reduce the arbitrariness of further communications. The selection of a topic for communication would steer communication into a certain direction and exclude other directions. In each situation other knowledge would have to be actualized. He defines knowledge as cognitive stylized sense [56: p. 138]. Knowledge would be a cognitive experience that has to do with expectations and observation. Knowledge would be permanently actualized and hence could not be stored statically.

For Daniel Bell knowledge is a ”set of organized statements of facts or ideas, presenting a reasoned judgement or an experimental result, which is transmitted to others through some communication medium in some systematic form. […] Knowledge is that which is objectively known, an intellectual property, attached to a name or a group of names and certified by copyright or some other formal recognition“ [10: p. 181f].

The classical philosophical distinction between scientific-technical and practical knowledge can also be found in science today. Walter L. Bühl [12] has conceived an evolutionary theory of knowledge and distinguishes four evolutionary types of knowledge: magical knowledge, mythical knowledge, ideological knowledge, and reflective-discursive (scientific) knowledge. Hans Mohr [66] distinguishes between theoretical-cognitive (scientific) and action-relevant knowledge. The latter would exist in two types: as disposing knowledge (practical-problem solving knowledge) and as orientating knowledge (ethical). Jean Francois Lyotard [55] distinguishes between scientific-technical and narrative (practical) knowledge.

These approaches have in common that they conceive knowledge as ideas, mental products of cognition, categories of thought. The problem with such approaches is that they neglect that knowledge implies social relationships of human actors that have emergent material results. Knowledge is not a purely

subjective attribute of a cognitive system, cognitive systems are socially related and in co-operative processes some of their knowledge is objectified in knowledge products that are produced synergetically in a joint effort within a shared environment. Conceiving knowledge as cognitive attribute neglects the social and the objective dimensions. Such approaches can be considered as reductionistic individualism.

For constructivists there is no objective knowledge, knowledge is conceived as a subjective construction. E.g. Heinz Von Foerster [86, cf. also 89: pp. 97f, 90: pp. 306, 341-345) stresses that information is not a good or a 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. What is transported wouldn't be information, but data or signals. Shannon's theory of communication wouldn't be an information theory, but a signal theory. Information would always involve the interpretation of data by a human subject. It wouldn't be stored in books or libraries because it would be bound to a human subject. Such entities would only be carriers of potential information [89: p. 98]. Knowledge wouldn't be a thing that is funnelled into human heads, it would require active construction [90: p. 306]. Von Foerster tends to conceive knowledge subjectively as embedded in the human brain, but he is right in stressing that due to the importance of the human actor and its context in the communication process there can be no certainty of communication. Communication always implies a *certain* degree of unpredictability, uncertainty, openness. This is due to the non-triviality, i.e. non-linearity and complexity, of the human being and social systems.

In respect to self-organizing systems, the approach to knowledge of Humberto Maturana is of specific importance. Hence we want to give specific attention to this subjectivistic theory. For Humberto Maturana and other constructivists there is no objective knowledge, knowledge is conceived as a subjective construction. Knowledge would be the observation of effective behaviour in a given context. There would be no object of knowledge. "Knowing is effective action, that is, operating effectively in the domain of existence of living beings" [64: p. 29]. "We admit knowledge whenever we observe an effective (or adequate) behaviour in a given context, i.e., in a realm or domain which we define by a question (explicit or implicit)." [64: p. 174]. "The question, 'What is the object of knowledge?' becomes meaningless. There is no object of knowledge. To know is to be able to operate adequately in an individual or cooperative situation" [63: p. 53]. "All doing is knowing and all knowing is doing" [64: p. 27].

Knowledge would be cognitively attributed to itself or something else by a living system when it observes something it considers adequate behaviour. "Knowledge is an interpersonal relation in the domain of consensual coordinations of consensual coordinations of behaviours. Or, in other words, knowledge is something that we attribute to ourselves or to some other when we see what we consider adequate behaviour in a particular domain in ourselves or in the other, and we frequently use the attribution of knowledge for doing something together in some domain of coordinations of behaviours. If we are not aware of this situation, we act treating knowledge as a manner of referring to entities that are assumed to exist in reality, that is, in a domain of entities that exist with independence of what we human beings do. In these circumstances the search for knowledge becomes a never ending quest of the thing in itself" [62].

Maturana is right in stressing that knowledge requires an interpersonal relationship and is based on activity. Be he neglects that knowledge not only has a cognitive dimension, but is also embodied, i.e. objectified, in artefacts and collective social actors (organizations) that exist outside of human cognition. There is always an object of knowledge, subjective knowledge refers to the material and social world outside of the individual, it is a non-linear, complex reflection of the outside world and of the social relationships and history of the individual. In communication the interacting partners are both subjects and objects, they form a knowledge relationship, communication means mutual objectification of subjective knowledge in the cognitive structure of the communication partners. Maturana neglects the

objective dimension of knowledge. Constructivists tend to say claiming an objective dimension of knowledge means that knowledge is independent of the human being, that cognition is only a passive process, not also an active one that is the foundation of transformative human practice, and that there is a linear, fully determined reflection of outside reality within a material system. But a non-naïve realistic theory of knowledge is far from such assumptions. Reflection means that material reality causes sensations in a non-linear way. Material reality is objective in the sense that it existed prior to humans and society, that it is endlessly changing and produces different organizational levels of matter. The human being and its consciousness form one of these levels that is based on interaction and exchange of matter between external world and the body. The material world, in the case of the human being that is nature and society, causes sensations, i.e. the human being is embedded into a web of material and social connections that influence its thinking and its actions. Material reality *evokes* sensations and thoughts in our brains, but does not determine the exact content of these thoughts, there is no identity between thoughts and material reality.

The main problem with Maturana is that he says that there is no reality outside the brain, reality would only be subjectively constructed, knowledge would *solely* exist as a construction in the brain. Such a theory is solipsistic in the sense that the world that a subject cognitively imagines is the only reality. Maturana argues that a living system doesn't obtain information from its environment because "the states and the transitions of states of any system is determined by its organization" [61: p. 458]. Cognition would always be bound to the knower, it would be a subject dependent process [61: pp. 459f]. "Cognition as a process is constitutively bound to the organization and structure of the knower because all the sates and interactions in which the knower can enter are determined by his organization and structure" [61: p. 460]. Cognition surely is based on subjective processes, but Maturana neglects the importance of outside information, in his theory cognition is not conceived as subject dependent, but as subject *determined*. Cognition would be connected to outside perturbation, but due to the autopoietic organization of the brain the cognitive changes would occur as "internal states of the system regardless of the nature of the perturbations" [61: p. 361], autopoietic systems would be "systems without inputs or outputs" [61: p. 360]. This is a contradictory statement, Maturana on the one hand says that outside perturbations have a certain relevance, but on the other hand he says the content of these perturbations is completely irrelevant and that autopoietic systems are informationally closed. When Maturana says "cognition is a subject dependent phenomenon" he means that cognition is subjectively determined and takes place in a fully informational autonomous autopoietic system that isn't influenced by the knowledge of other knowledge systems. "Self-organising systems are intrinsically open systems, and if information is a central aspect of organisation, which it surely is, autonomous biological systems must be open to information as well as energy and matter. This is denied by the definition of autopoiesis" [18: p. 292].

2.2. Objectivistic Approaches

Nonaka and Takeuchi [70] speak of organizational knowledge that is based on personal knowledge. Organizational, institutionalized knowledge would be stored in anonymized rule systems, artefacts, routines, patterns, and practices that are independent from single individuals and define the modus operandi of a social system [1,2, 21, 83, 93]. These are "maps, memories, and programs" [1: p. XXII]. Helmut Willke [93] distinguishes between implicit, explicit, public and proprietary knowledge.

In economics knowledge has been considered as what enables someone to get what he wants at a price. "Information-gathering institutions such as the market enable us to use such dispersed and unserveyable knowledge to form super-individual patterns" [46: p. 15]. The market would transmit knowledge about prices, "of the basic fact of how the different commodities can be obtained and used" and about "alternative possibilities of action" [45: p. 51].

For Nico Stehr [81, 2003] knowledge is a "capacity for action", the "capacity to set something in motion". It would exist in objectified and embodied form, even if it may in fact be left unused.

Max Scheler [77, 78] has made a typology of knowledge that conceives the latter as absolute and objective. He distinguishes myth and legend, knowledge that is implicitly given with the in the natural folk language, religious knowledge, mystic knowledge, philosophic-metaphysical knowledge, positive knowledge (in mathematics, the natural sciences, and the humanities), and technological knowledge. Walter Bühl [12] distinguishes between between practical (objectified) and theoretical (scientific) knowledge. Forms of practical knowledge would be habitus (acquired dispositions of thinking and acting, cf. [11], habitat (objects of the spatial-temporal natural and cultural environment), operational knowledge (how to use technologies), and objective knowledge (knowledge incorporated in technologies). Technological knowledge would be a combination of operational and objective knowledge.

These approaches have in common that they stress that knowledge is a material artefact or social organization that exists outside of human subjects. Knowledge is conceived as super-individual pattern that is stored in organizations, institutions, and things, and exists outside of a knowing subject. The problem of these theories is that they don't take into account the importance of human agents in society, they neglect the subjective dimension of knowledge Conceiving knowledge purely as a material thing or social organization lacks the fact that knowledge isn't possible without knowledgeable, active human beings that enter social relationships in order to compare and co-ordinate their knowledge in such a way that shared knowledge constructs emerge.

2.3. Dualistic Approaches

Karl Popper argues that there is knowledge in the subjective sense consisting of dispositions and expectations, but that there is also objective knowledge consisting of linguistically formulated expectations submitted to critical discussion [72: p. 66]. He argues in rationalist tradition that most of our knowledge and dispositions are inborn and inherited. Subjective knowledge would be possessed by some knowing human subject, it would be a state of mind or of consciousness or a disposition to behave or react. Objective knowledge would consist in the logical content of theories, conjectures, guesses [72: p. 73]. "Knowledge in this objective sense is totally independent of anybody's claim to know; it is also independent of anybody's belief, or disposition to assent; or to assert, or to act. Knowledge in the objective sense is knowledge without a known: it is knowledge without a knowing subject" [72: p. 109]. Objective knowledge would also exist if it is not recognised by the human being, "a book remains a book […] even if it is never read" [72: p. 115]. Examples for objective knowledge would be theories published in books and journals and stored in libraries. Popper called the world of subjective knowledge world 2 and the world of objective knowledge world 3. World 3 would contain theories, arguments, conjectures, journals, books, problems, and problem situations. It would have an independent existence, although a human creation, it would create its own domain of autonomy [72: p. 118]. Popper distinguished three worlds of existence: "first, the world of physical objects or of physical states; secondly the world of states of consciousness, or of mental states […] and thirdly, the world of *objective contents of thought*, especially of scientific and poetic thoughts and of works of art" [72: p. 106]. World 3 is the world of objective knowledge, it contains products of the human mind that continue to exist independently of their originators. It has been created by human beings, but is independent of their existence. "The third is the world of intelligibles, or of *ideas in the objective sense*; it is the world of possible objects of thought: the world of theories in themselves, and their logical relations; of arguments in themselves; and of problem situations in themselves" [72: p. 154].

Popper talks about both subjective and objective aspects of knowledge, but for him these two domains are independent. World 3 is created by world 2, but exists independently of it. He misconceives the

relationship of subject and object as dualistic, and doesn't take into account that the knowledge of human individuals and social structures is mutually connected and produces each other. Popper constructs a a dualism between human actors and objective structures. The objectification of human activity for Popper are only things that make up world 3, books, artworks, videos, computers, papers, etc., he doesn't see that also collective organizations (like enterprises, parties, universities, etc.) are an objectification of subjective human knowledge and activity.

In order to overcome the shortcomings of subjectivistic, objectivistic, and dualistic approaches on knowledge I suggest a dynamic concept of knowledge that is based on the concept of social self-organization. I will now first outline some aspects of the concept of social self-organization, then I will try to show how this concept can be used in order to interpret knowledge as a dynamic process.

3. Knowledge and Social Self-Organization

In order to show that the one-sidedness of both subjectivistic and objectivistic theories of knowledge can be overcome by a dialectical synthesis, first some foundations of a theory of social self-organization have to be outlined.

3.1. Foundations of Social Self-Organization

We approach the topic of knowledge from a research program we call the Unified Theory of Information (UTI) that has been developed during the last ten years (see http://www.uti.at). The main idea of the UTI approach is to consider information as an evolutionary entity that can be found on different developmental stages and in different system types. 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, have higher complexity and emergent properties. Merging aspects from semiotics with such a concept of emergent evolution opens up the possibility for a general conception of information which conceives information as an entity that is being produced by self-organizing systems and has different as well as common meanings in different types of systems. Self-organizing systems are information-generating systems and they embody information as structural properties.

A self-organizing systems 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 can't 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 [3]. 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.

Social analysis has to begin with individuals producing in a society, i.e. the existence of living human individuals. The active human being is the component or element of a social system. Human activities are the foundation of social systems, hence they could also be could human action systems.

We term the self-organization of social systems "re-creation". Societal structures don't exist externally to, but only in and through human agency. By 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 forecasted 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 permanent processes of agency and constraining/enabling a system can maintain and reproduce itself (see fig. 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 actions (which are a correlation of mutual individuality that results in sociality).

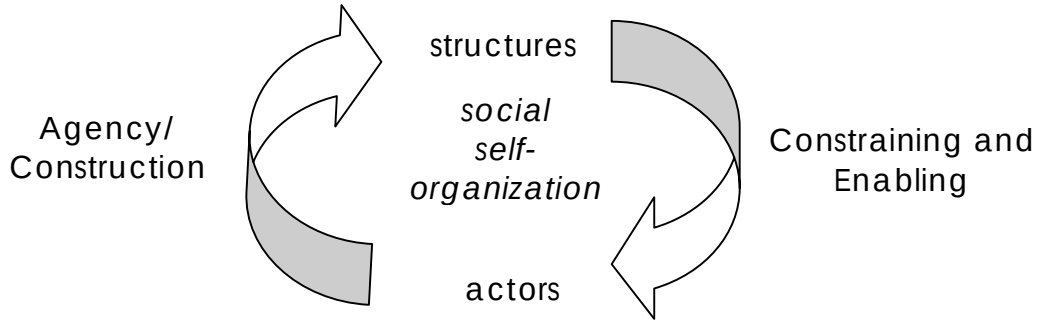

Fig. 1.: Self-organization in social systems[1]

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 humans to consciously shape and create systems and structures, an ability that is based on self-consciousness and, in Anthony Giddens' [42] terminology, the reflexive monitoring of action. Societal systems are re-creative ones because they can create new reality, the socio-cultural human being has the ability to create the conditions for his further evolution all by himself. Creativity means the ability to create something new that seems desirable and helps to achieve defined goals, it's a central feature of communicative action. The mutual productive process of re-creation describes the reflexive, self-referential nature of society in which structures are medium and outcome of social actions [42: pp. 25f, for the relationship of Giddens' theory of structuration and social self-organization see 27].

The self-referential process we call re-creation describes the synchronous aspect of social self-organization in the sense of self-reproduction of society or social autopoiesis. But one has to keep in mind that there is also a diachronic moment in the sense of "order from noise". Theories of social self-organization such as the one of Niklas Luhmann [57] that describe society as a self-reproducing or in analogy to Humberto Maturana and Francisco Varela as a autopoietic system, have been criticised as putting forward static and functionalistic conceptions. A number of authors [51, 52, 54, 68] has tried to conceive sociological models in analogy to Heinz von Foerster's [84] and Ilya Prigogine's principle of order through noise/fluctuation [69, 74]. They see society as a system where not equilibrium and stability is the normal state, but non-equilibrium and instability.

Applying the principle of order from noise to society means to acknowledge that the overall self-reproduction of society is not a smooth, permanently stabile process, it is in constant flux and from time to time enters phases of crisis. These are periods of instabilities where the further development of the overall system is not determined. In modern society, periods of crisis are caused by developing structural

[1] This model of social self-organisation was first introduced by Wolfgang Hofkirchner [49] and elaborated in a number of further works such as [25, 26, 27].

antagonisms. Phases of stabile re-creation result in phases of instability where the future development of the system is highly undetermined. Objective social structures condition a field of possibilities, it is not pre-determined which alternative will be taken. 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 taken. Certainty can't be achieved, but agency also is not made impossible by the principles of self-organized social change. The whole movement of social self-organization is based on a dialectic of chance and necessity. It is determined that a certain social formation or mode of social development will collapse and enter crisis, but the exact causes, the exact point of time as well as the outcome of the crisis is not determined. Concerning a point of bifurcation 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 confronted with an end of certainties [92].

There are two types of re-creation: the integrative, reproductive one and the disintegrative, discontinuous one [see 11: p. 165]. They don't exist independently because it is determined that each social formation and mode of development enters a phase of instability, but it is uncertain when this will be the case, what the exact reason and the outcome will be. We both find continuity and discontinuity in society. Social systems are historical systems [91], they have a beginning and an end, as well as re-creative dynamics in-between.

A social system is a complex, non-linear system that is not mechanically determined. Certain aspects of its development are conditioned by existing structures, but there is also a certain freedom to choose between different possible actions for the human actors. This is due to the fact that they are self-conscious, active, knowledgeable beings. The human being introduces a certain degree of chance, noise, and unpredictability as manifestation of the freedom to choose into a social system. In Heinz Von Foerster's terminology society is a non-trivial system. Trivial systems are predictable, history independent and deterministic, non-trivial systems are history dependent and to a certain extent indeterminable, unpredictable [87: pp. 8-13]. This means that society is a complex, non-linear system. Certain stimuli of social activity don't 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. Human actors are not a uniform mass, they have different experiences, values, living conditions, and contexts of action and thinking. This implies the non-linearity and complexity of social systems. But this doesn't 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 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 see [26]).

3.2. Knowledge-Generation in Self-Organizing Social Systems

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 cognitive attribute nor purely an objective entity, it is a process and relationship between active human agents that participate in a self-organizing social system and co-ordinate their subjective knowledge in such a way that objective knowledge emerges. Knowledge is a manifestation of information in social systems that involves the interpretation, evaluation, and usage of data and can be found in various subsystems of society. Knowledge is a threefold process of cognition, communication, and co-operation.

In knowledge management research a distinction between data, information, and knowledge is made (cf. e.g. [93: pp. 7-18]): Data is considered as a coded resource of operations, it is transformed into information when it is integrated into a relevant context where it makes a difference as a difference, it gains relevance and meaning relative to an integrating system. Information is transformed into knowledge when it is integrated into a context of experience. Knowledge is information embedded into experience. Such a distinction fails to identify a concept that generalizes all three forms, it is only interested in specific aspects, not in the common aspects that integrate these forms. We suggest that information is a general concept that can be found in all self-organizing physical, biological, and social systems. In knowledge management information is confined to the social realm, this is a narrow concept of information. In a human living system, data is a manifestation of information, when it is interpreted and integrated into the cognitive system it is transformed into knowledge, knowledge that is embedded into practical experienced situations is transformed into practical knowledge. Hence we suggest that the triad is not data-information-knowledge, but data-knowledge-practical knowledge as a manifestation of information in the human realm.

Information is a relationship that exists as a relationship between specific organizational units of matter. In the case of a social system, we speak of knowledge as the social manifestation of information and the units of organized matter are active human (individual or collective) actors. Reflection (Widerspiegelung) means reproduction of and reaction as inner system-changes to influences from the outside of a system. There is a causal relationship between the result of reflection and the reflected. The reflected causes structural changes, but doesn't mechanically determinate them. There is a certain, relative autonomy of the system, this autonomy can be described as a degree of freedom from external determination. On the different organizational levels of matter we find different degrees of freedom. The degree of freedom increases along with complexity if we go up the hierarchy from physical-chemical to living and finally social systems. The causal relationship between the reflected and the result of reflection is based on a dialectic relationship of freedom and necessity. Information is an objective relationship between the reflected and the result of reflection. This includes both a changing of the system's structure caused by environmental stimuli and the realization of functions of the system within the reflected environment of the system. This means that information is a relationship of reflection between a system and its environment, to be more precise between units of organized matter. Information is not a structure given in advance, it is produced within material relationships. In a social system, knowledge means that human actors communicate in such a way that a stimuli (such as the uttering of one individual) causes changes within the social systems the actors constitute. They react to such a stimuli and produce a new emergent result. This result reflects both the stimuli and portions of the subjective knowledge of the involved actors in a non-linear way. So reflection doesn't mean that an outside reality is mechanically copied or reproduced within the system, it means that a complex, non-linear relationship between cause and effect is established in a self-organizing social system.

When two human systems interact (see fig. 2), they enter an objective relationship, i.e. a (mutual) causal relationship is established. A portion of subjective, systemic knowledge ("*cognition*") is communicated from system A to system B (and vice versa, "*communication*"). The cognitve structural patterns that are stored in neural networks within the brains of individual human agents can be termed subjective knowledge. 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 don't know to which extent this will actually be the case, which new subjective knowledge will emerge, how knowledge structures will be changed etc. There are degrees of autonomy and freedom (=chance). If structural changes in system B take place and are initiated by system A, this means an objectification of subjective knowledge of A in B

from the point of view of A. From the point of view of B it means subjectification of objective knowledge from its environment. In a communication process, this also takes place the other way round. As a result of communication it cannot only be the case that an objectification of knowledge in some of the involved systems takes place, it can also be the case that due to the synergies between the systems new qualities (knowledge) emerge in their shared environment (*"co-operation"*). Structural, subjective knowledge of the involved systems is co-ordinated, synergies arise and hence something new is produced commonly in a self-organization process. The new structure or system that arises is an objectification of (parts of the) subjective knowledge of the involved systems. Knowledge in self-organizing social systems has cognitive (subjective), communicative (new subjective knowledge (=cognitive structures) emerges in systems due to interaction) and co-operative aspects (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 involved actors. By communication these actors co-ordinate their subjective knowledge and mutually enhance their knowledge. This communication can result in co-operative processes, i.e. in a co-ordination of activities that results in 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 of 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's why purely objective concepts of knowledge 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 a foundation of all organizations. That's 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.

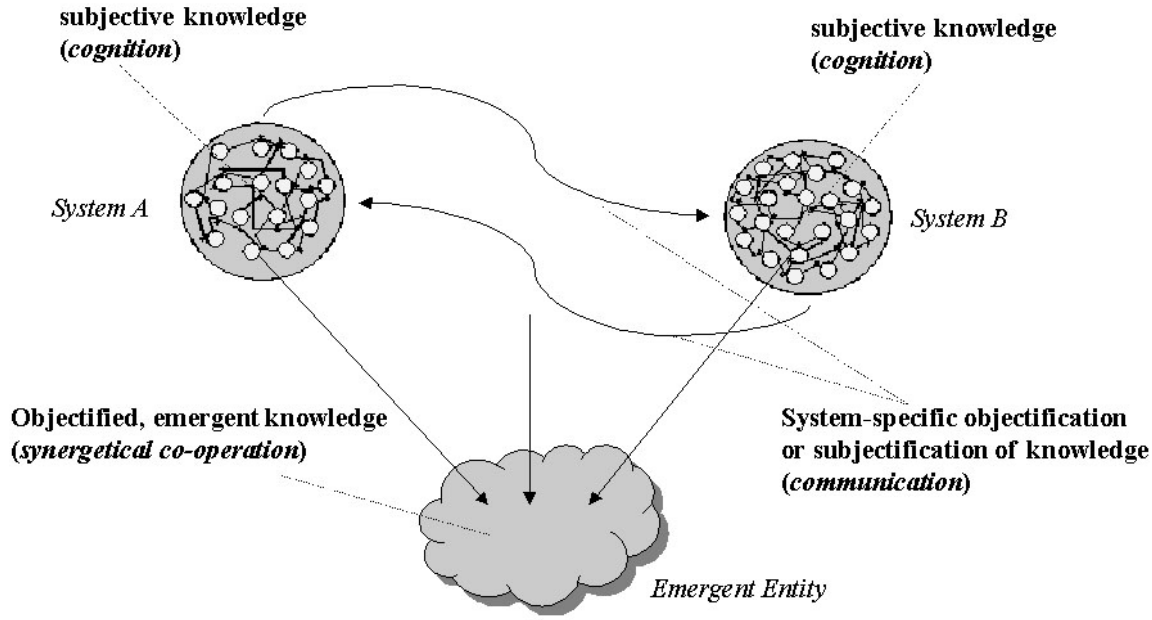

Fig. 2: A model of knowledge as a threefold process of cognition, communication, and co-operation in social systems

By social co-operation synergies are produced that result in new emergent objective knowledge. Co-operation means that human actors co-ordinate their actions and communication in such a way that they

identify shared goals and by making concerted use of existing structures produce new reality that benefits all of them and could not have been produced so quickly and efficiently on an individual basis [cf. 25].

A human individual has a specific cognitive structure which is influenced by social structures and by the social relationships it enters and by which it influences processes of agency. In social systems individual values, norms, conclusions, rules, opinions, ideas, and believes 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 that 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 moments. This process is always influenced by society and the social relationships the individual enters, but it is never determined by them. So e.g. we find 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 that have a certain degree of freedom of action and thinking. The extent of this degree depends on the degree of participation and democracy of 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 speaks in favour of the term individual/subjective knowledge because it takes into account that individuals have unique and complex cognitive structures.

A sign can be seen as the product of an information process. An information process occurs whenever a system organizes itself, that is, whenever a novel system emerges or a qualitative novelty emerges in the structure, state, or behaviour of a given system. In such a case information is produced. It is embodied in the system and it may then be called a sign. 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 informational happening 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 threefold cognitive self-organization process can be summarized (cf. fig. 3, for details cf. [50]): First signals from the environments are perceived and transformed into data, second data are interpreted, knowledge emerges as interpreted data, third knowledge is evaluated, it gains a practical dimension that is oriented on problem-solving, it is transformed into practical knowledge. Data are stimuli that are perceived from the environment, but they are not a form of knowledge. Subjective knowledge is formed on the second and third level, it always involves interpretation and evaluation.

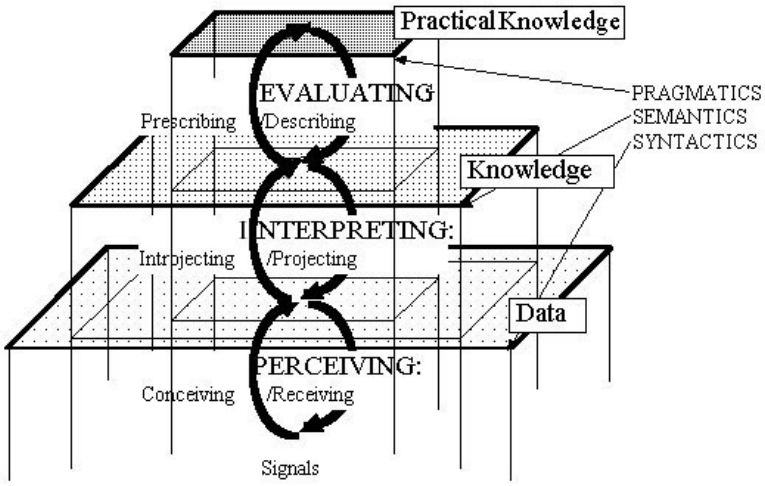

Fig. 3: The Generation and Differentiation of Individual/Subjective Knowledge

We argue that knowledge has both subjective and objective aspects. A purely constructivist theory of knowledge is solipsistic, a purely realistic theory of knowledge is naïve, epistemological constructivism/ontological subjectivism and epistemological realism/ontological objectivism have to be combined in order to establish a feasible theory of knowledge. Knowledge is as remote from pure subjective construction as it is from pure objective representation. We argue in favour of both a modest constructivism and a modest realism, a constructive realism where knowledge is a constructive reflection and construction is mental, social, and material production. Radical constructivists tend to argue that knowledge is tied to cognition, is a subjective construction, doesn't exist independent of an observer in the outside world, that "knowledge products" only carry potential knowledge because knowledge would be in need of human interpretation and meaning, etc. They don't take into account that knowledge that is materialized in technologies, artefacts, collective social organizations is an expression of the expertise, experience, practice, meaning etc. of active human beings that enter social relationships where they jointly produce knowledge products. Hence knowledge is indeed objectified/materialized in artefacts as well as in social organizations, it in them gains objective existence. Radical realists tend to argue that knowledge exists independent of human actors in artefacts. This is also a mistake because knowledge as a social relationship is never independent of human individuals, it is intrinsically linked to their thinking and social practice. If an old book that no one any longer is interested in is kept in the magazine of a library, can it be considered as knowledge or not? A radical constructivist will answer: "No, it is only potential knowledge because it is not practically used and cognitively interpreted by anyone". A radical realist will answer: "Yes, it is knowledge because it is data stored in a material substance". A correct answer would be: "It is objective knowledge as a result of past human practice, it stores facts about past experiences. 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 subjective knowledge in the sense of a lived practical experience and interpretation of existing, 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 that 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 not independent of past and present human experiences. Technologies like software, computers, computer games, hardware, handys, 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.

Due to the selectivity of the communication process, knowledge has a certain degree of uncertainty. On the other hand information is also an objective, reflective social relationship: If actors communicate, knowledge exists as an objective relationship between them and this relationship involves reflection. Reflection (Widerspiegelung) doesn't mean the mechanical reproduction of data by a receiver, it only means that in the case of communication there is a reaction of one communication partner to the symbolic actions of the other partner. It is determined that he reacts and in this reactions he makes uses of symbols, otherwise one couldn't speak of communication. But it is not determined how he reacts exactly, this is relatively open, but frequently also to a certain extent predictable due to certain regularities and standardised modes of behaviour that can be found in the social world. Such reflective reactions are neither completely determined, nor completely undetermined, their causality can be characterised as relative chance and incomplete determinism. Such objective knowledge relationships occur milliards of times per day in relatively stable manner, hence knowledge as a social relationship is relatively probable. However there are degrees of uncertainty due to different dispositions, norms, values, habitus, cultural contexts, interpretative schemes, tastes, life-styles etc. of the partners in a communicative setting.

Knowledge exists in all social relationships, but it has different effects. We neither photographically and mechanically map knowledge, nor are we autonomous knowledge producers. Due to certain normative dispositions certain reactions and interpretations to a stimulus are more probable than others. But the human being is a being that can change his views during productive discourses, hence social knowledge relationships not only increase the knowledge of a subject, they also result in a (faster or slower) differentiation of definitions. Human interpretation is neither mechanical mapping, nor coincidental construction, but constructive reflection (konstruktive Widerspiegelung). Reflection involves reaction to external stimuli during the course of communications where different alternative interpretations and behaviours are possible. It depends on the degree of participation and democratisation of society to which extent interpretation and critical reflection are activated.

Structures are totalities of durable and institutionalized behaviour. They can be found in all subsystems of society. Structures mediate communications and actions, they are 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 the durable connectivity of human beings, they are shared spaces of living, working, and incorporate both interacting human actors and artefacts that the latter make use of. Social structures are media of society because they mediate social actions and communications. They store and fix knowledge and hence they simplify actions and communications because the foundations of these processes don't 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 distanciation 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 foundation of action and communication, they enable a certain degree of mobility, they mediate, organise, and co-ordinate social relationships and communications.

The brain contains and stores subjective knowledge, communication means a comparison of subjective knowledge of different actors. Knowledge of actors is contained in the social relationships they enter. Communication means knowledge production, this knowledge can be assessed as being useful or not. By the mutual mediation of subjective knowledge, new objective knowledge can emerge in a creative

process. Social knowledge relationships contain permanent flows of subjective knowledge between actors, these flows can become productive. Such a production process results in the differentiation of the cognitive knowledge structures of the involved actors and the emergence of objectified knowledge. Each day we enter multiple knowledge relationships that don't affect our subjective knowledge, but other experiences, relationships and communications change our views, norms, values, interpretative schemes etc. In such a case, knowledge flows are considered as meaningful, a knowledge relationships gains a productive dimension.

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 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 each such situation. Objective social knowledge can be seen as a durable foundation of social actions that nonetheless changes dynamically.

The basic process of self-organization that has been illustrated in fig. 1 takes place in five subsystems of society. In the technosphere the human being makes use of tools as a means for achieving defined goals by transforming nature. The structures that are medium and outcome of human agency here are technological artefacts. In the ecosphere the human being transforms nature in such a way that it can organize natural resources in such a way that it can utilize these resources for its needs and goals. The structures that are medium and outcome of human agency here are natural resources. In the economic system the human being makes 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 medium and outcome of human agency are economic property. In the political system the human being established power structures in order to achieve collective decisions. Here the structure that is medium and outcome of human agency is political decision power, i.e. social rules. In the cultural system the human being produces a set of norms and values that define living conditions and life-styles. Here the structures that are medium and outcome of human agency are definitions, collective norms, values, morals, 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 because in the first economic knowledge is the dominant structure that is produced and 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.

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 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 foundation of further cognition, actions, communication, and co-operation, they enable and constrain social phenomena. So the dialectic of structure and action that lies 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 4 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 foundation 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 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.

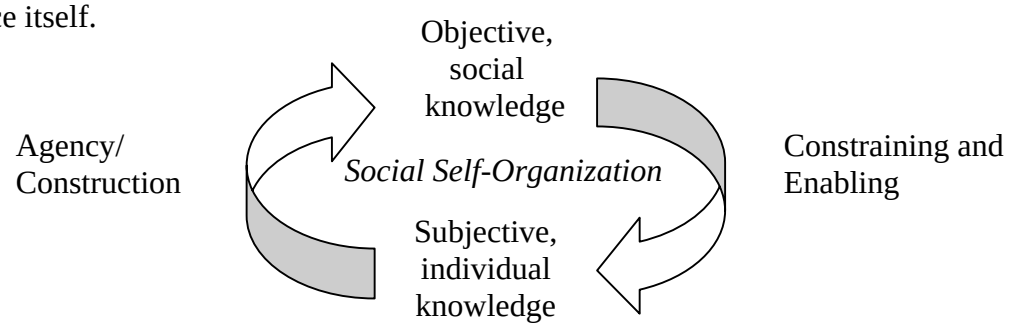

Fig. 4: The informational level of the re-creation of social systems.

The five basic cycles of social self-organization that we have lined out can also be summed up to a general model of systemic social self-organization that consists of three self-organizing loops (fig. 5, cf. [24]).

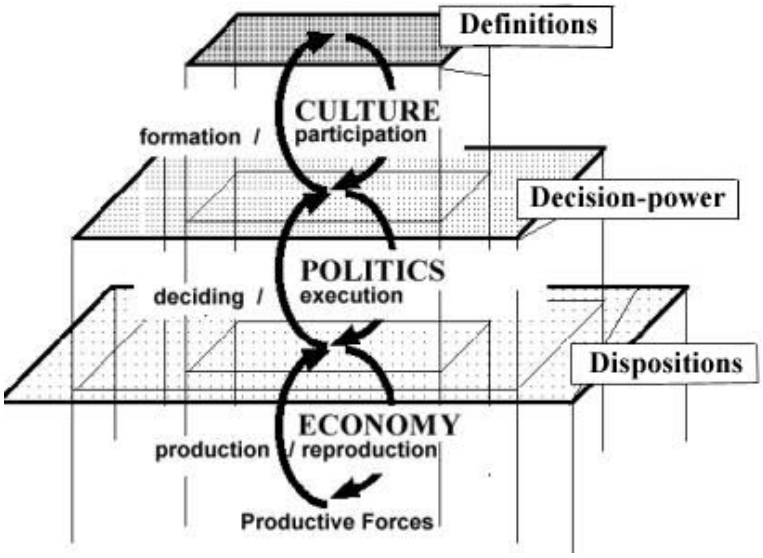

Fig. 5: The Re-creation of Society as a Whole

System	Actors	Structures	Cognition	Communication	Co-operation
Ecology	Human Individuals and Groups	Natural Resources	Mental construction of the transformation of nature	Appropriation of natural resources	Ecological sustainable appropriation and usage of natural resources
Technology	Human Individuals and Groups	Tools	Mental construction of tools	Production and usage of tools	User-friendly production and usage of tools
Economy	Producers, Workers, Managers, Capitalists	Property, Use Values	Mental construction of use values	Production, labour process, consumption, distribution of use values, management	Self-management
Polity	Individuals, Political Groups	Decision power	Production of political ideas, identities and values	Political processes: political discourse, lobbying, voting, campaigning, protest, devising and passing laws	Grassroots democracy, political participation
Culture	Individuals, Value-based Communities	Definitions (norms, values, meanings, traditions)	Production of meanings and values	Normative discourses and struggles	Unity in Diversity
Mass Media	Mass media institutions, consumers	News, entertainment	Conception of media contents	Production, transmission, reception, and interpretation of programmes/media contents	Dialogic mass media maintained and co-ordinated by prosumers (producers that are consumers and consumers that are producers), participatory media

					participatory media
Science	Researchers, Research groups	Theories	Production of scientific ideas	Scientific discourse, publishing of articles/journals/ monographs, giving lectures and talks, organizing conferences, criticism	Participatory science, scientific discourse and critique as general social phenomena
Art	Artists, recipients	Artworks	Production of artworks, interpretation of artworks	Discourses on artworks, social interpretation processes of artworks, asynchronous communication of the artist and the recipients	Participatory art, common production of artworks, recipients as artists (as e.g. in happenings, performance art, Web art, virtual art)
Education	Students, teachers	Skills	Acquiring and testing theoretical and practical ideas (e.g. reading a book, listening to lectures)	Lectures as communicative encounters of teachers and students, discussions, criticism	Participatory education (teachers as students and students as teachers)
Sports	Athletes, teams	Games, game rules, physically recreated bodies	Conceiving individual game strategies, individual physical recreation	Conceiving game strategies in social processes, matches, contests	Participatory sports (sports as generally accessible games that are co-operatively co-ordinated)
Medicine	Physicians, patients	Healthy bodies	Observation of one's body	Therapy, surgery, consultation	Participatory medicine (mature patients and committed, responsive physicians)
Ethics/ Belief Systems	Believers, unbelievers, leaders	Dogmas, rules of conduct	Production and reproduction of personal values, individual rites	Rites and ceremonies	Participatory ethics (joint production of reasonable values)

Tab. 2.: Actors, Structures, and Knowledge Processes in the Subsystems of Society

Table 2 gives an overview of the basic aspects (actors, structures) of the self-organization of the subsystems of society, and of the threefold knowledge processes (cognition, communication, co-operation) that shape and enable the self-organization of these systems. As the main subsystems of society ecology, technology, economy, polity, and culture are identified. Specific attention is given to the cultural system and its subsystems. Culture is the social system that produces common meanings that signify certain entities in a self-organizing system, this process is based on a mutual productive relationship between the subjective culture of a human being (its ideas, norms, values, beliefs) and objective cultural structures (meaningful cultural artefacts with symbolic content, and collective norms, ideas, values, rules, traditions, world-views (Weltanschauung) ethics, morals) [36]. The cultural subsystem of modern society that produces collective meaningful structures that represent world-views, rules, norms, values is itself organized in the way of a number of subsystems [36] such as the mass media [cf. 34, 35, 38], science [cf. 30], art [cf. 40], education, ethics/belief systems, and systems of physical recreation like sports and medicine. Whereas systems like the mass media, education, ethics, and art

recreate the human mind, recreational systems like sports and medicine have the function of recreating the human body. This shows that the cultural system aims at the recreation of body and mind of the human being. In its self-organization it not only recreates the human being, but it also produces collective world-view patterns and meaningful products and structures that influence the way people live, act, and think. In this respect culture is a whole way of life affecting social relationships as well as the human body and mind. In the political system political groups co-ordinate the distribution of decision power (i.e. the capability to influence collective decisions), in modern society the political system is organized within nation states (and increasingly on a transnational level), is based on the competitive encounter of political parties, state-based institutions and organizations (parliament, ministries, government, parliamentary parties, repressive state apparatuses such as courts, police, military, etc.), and civil society organizations (non-government organizations (NGOs)) that aim at the accumulation of power [cf. 32, 37]. The self-organization of the economic system is generally oriented on the production, distribution, and consumption of use values in labour processes, in modern society it is a system that is oriented on the accumulation of economic capital by producing exchange values in the form of commodities that are produced by wage labour and privately owned by capitalists [cf. 23, 31, 41]. In table 2 co-operation as an aspect of knowledge and as analytical dimension of social systems represents the idea that the essence of society is the maximization of socialization and hence that a fully developed socially self-organizing system is a participatory system where all human beings live in wealth and social security, own collectively what they produce, can participate in collective decision processes, can determine and realize themselves (for the idea of a co-operative participatory society cf. [25, 29, 33]). Participation allows an effective usage of the knowledge of human beings in such a way that they can share and jointly co-ordinate their knowledge in order to produce new knowledge. Sharing and communicating knowledge in order to co-operate allows creative synergies between human beings that result in the emergence of new knowledge in a system. Sharing, partnership, and co-operation also seem to be ethical imperatives for a sustainable and participatory management of knowledge that allows benefits for all members of an organization. We individually and collectively have the right and responsibility to design the systems we live in. A system should be designed in such a way that all its members can adequately participate in it and can benefit from their participation. Co-operation and participation allow the shared usage of the knowledge of a system's participants. Creative synergies can arise from interactions that result in novelty and innovation.

The theory of knowledge we suggest conceives knowledge as a dynamic social process of cognition, communication, and co-operation. Hence we oppose static theories of knowledge that neglect the dynamic and historical character of knowledge. In the classical sociology of knowledge such static and ahistorical conceptions have been put forward by idealistic thinkers like Max Scheler who consider knowledge as endless, timeless spiritual entity that forms the substance of social existence. For Scheler [77] the sociology of knowledge was part of cultural sociology that would research timeless characteristics of man. In the Platonic tradition Scheler argues that ideas are pre-existent to their realisation, they would be changeless and timeless. He calls this realm of fixed knowledge the "absolute sphere". Changing material reality would be secondary and created by the world of endless ideas. The possibilities of being would be pre-determined by mind, the real cultural factors could only make a selection from these possibilities. For Scheler the essential ultimate is something pre-existent and ideal, floating above history, he postulates a supra-temporal, unchanging system of truths.
In opposition to Scheler, Karl Mannheim proposed a more dynamical theory of knowledge that conceives knowledge as historically developing. For him knowledge does not exist metaphysically outside or above history, but is constituted historically in social processes. Knowledge would be developing in such a way that a new knowledge system incorporates older knowledge, it forms a higher level, eliminates the old system, but also preserves it. It "sublimates" the old system [60: p. 170] and is organized around a new centre.

Norbert Elias [20] has pointed out that knowledge is subject to a long-term development process, it would have a "process-character" [20: p. 361] and a "character of a structured flux" [20: p. 364]. Thinkers like Mannheim and Elias have anticipated conceiving knowledge as dynamic process that has been made fully possible by the emergence of the theories of self-organization that are a suitable methodological tools for describing complex, dynamic, interrelated phenomena. Hence we see us standing more in the dialectical and materialistic tradition of Mannheim than in the static and idealistic tradition of Scheler.

We want to summarize some important basic characteristics of knowledge:

- Knowledge is a manifestation of information in the human-social realm. Knowledge doesn't 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" [60: p. 147].
- Objective knowledge is stored in structures and enables time-space distanciation of social relationships. It reduces the complexity of social systems, foundations of human existence don't have to be re-produced permanently due to its storage-function. Such storage mechanism of social knowledge include rules, resources, technologies, property, decision power, norms, values, traditions, myths, world views, codes, routines, guidelines, databases, organizations, institutions. Objective knowledge is a supra-individual structural entity [1,2, 21, 83, 93], but is based on human agency, it is medium and outcome of social actions, 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 show up and are due to the synergies produced by the co-operating efforts of knowledgeable actors. Intelligent organizations are based on the effective use and mangement of emergent knowledge.
- Knowledge must be permanently enhanced and updated.
- Knowing is intrinsically coupled to not knowing: Heinz Von Foerster [88, cf. also 89: p. 62, 90: p. 306] has stressed that there can be no absolute knowledge, there is much that we can't and don't know. The unknowable would consist of undeterminables and undecidables. If epistemology is a theory of knowledge or of understanding understanding, then one would also need a theory of the unknowable. Von Foerster calls such a theory lethology. This term is derived from Greek mythology where one assumed that one must cross the river Lethe in order to reach the Elysium and that during this journey one would loose memory. In the knowledge-based society, scientific and technological knowledge produces risks and hence phenomena that we don't know and can't fully predict.
- Knowledge has relevance for a system and is constituted within and part of human experiences [93].
- Knowledge is a social, common, public good that has a historical character. Knowledge production is a social process, in order to produce new knowledge one must refer to prior knowledge produced by others. Frequently knowledge production has a highly networked and co-operative character. Knowledge is a self-expanding resource, but can be artifically made into a scarce resource (e.g. by Intellectual Property Rights).
- Public knowledge gains importance when its distrubuted freely in high numbers, proprietary knowledge looses importance when the same happens to it.
- Knowledge is a non-substantial (*nichtstofflich*) good that is generally not used up by its manifold usage.
- Knowledge expands during its usage.

- Knowledge can be compressed.
- Knowledge can replace other economic resources.
- In fast networks knowledge can be transported at the speed of light.
- Purchasers of knowledge only buy copies of the original data.
- The costs of reproducing knowledge are generally very low and are further diminished by technological innovations and progress.
- In contrast to capital, knowledge appreciates with use, its marginal utility (Grenznutzen) increases with its use.

In section 3 I have outlined a dynamic concept of knowledge and have shown that all social systems are self-organizing systems and knowledge systems. Today there is much talk about the "information society", the "knowledge-based society", the "media society", the "communication society", etc. Such concepts point towards an increased importance of knowledge in society. Hence the concept of knowledge ultimately results in the question what the knowledge-based is. Knowledge is embedded into social relationships, it is a dynamic social co-ordination of ideas and values of different individual human beings. Questions concerning knowledge and the knowledge-based society also have ethical implications because one must pose the question how individual ideas and values can best be co-ordinated in social processes. In the next section of this paper I will make some remarks on the knowledge-based society and its ethical implications.

4. Towards a Responsible Knowledge-Based Society

Niklas Luhmann has made important contributions for a theory of social self-organization. Hence when we talk about the information society/knowledge-based society as a self-organizing system, we should also discuss Luhmann's ideas about this specific type of society. Luhmann is rather critical of the notion of the information society because he argues that in such concept spectacular singular phenomena like the information overflow caused by the mass media and electronic data processing – are considered as representative for the whole society [59: pp. 1089f]. There would be a massive increase in information production, but not in information usage, hence most information would only be potential information, the information society would be uninformed and the concept would be an euphoria that can't be justified rationally [59: pp. 1098ff]. Luhmann [58] identifies several qualities of information:

- Information is not stabile, it can't be transported, stored, or transmitted
- Information is an event.
- Information produces knowledge.
- Information is a difference that makes a difference.
- One searches for information in order to reduce uncertainty and to reach better decisions.
- Past societies that have tried to predict the future have already been information societies (e.g. ancient China, Mesopotamia).
- Information transforms non-knowledge into knowledge.
- Information permanently reproduces knowledge and non-knowledge [59: p. 1092].
- Information has to do with certainty and uncertainty (e.g. the information that the train will be 20 minutes late produces the uncertainty whether or not one should still have a cup of tea or not)
- Information must be novel in order to be information.
- Information is surprising [59: p. 1092].
- Information is situation-specific and can't be retained.
- Information is not transmitted into a system, but produced in a system.
- Decisions require information as a foundation.
- In modern society many complex decisions are necessary, hence the need for information increases.
- More and more structures are produced and transformed by decisions.

- A decision is an informed selection of alternatives.
- Information is a decay product, it disappears when it is actualised [59: p. 1090].

For Luhmann the specific characteristic of modern society is not that it becomes more and more information- or knowledge-based, but that more and more social structures are produced and transformed by decisions, there would be an explosion of the necessity to take decisions. "Die Veränderung scheint vielmehr darin zu liegen, daß immer mehr gesellschaftliche Strukturen durch Entscheidungen erzeugt und durch Entscheidungen geändert werden können. Das gilt heute für so gut wie alle Bereiche der gesellschaftlichen Kommunikation: für die Wahl von Regierungen und für das durchgehend positive Recht, für den Stand der Forschung, von dem weitere Forschung auszugehen hat, ebenso wie für Kapitalinvestition im Inland oder im Ausland, für das Angebot und für die Wahl einer Berufsausbildung und für alles, was als Realität angenommen wird, weil die Massenmedien darüber berichten. Selbst Religion ist zur Sache von Angebot und Entscheidung geworden und ebenso Eheschließung mitsamt der Frage, ob und wann man Kinder haben will und wieviel. [...] Diese Explosion von Entscheidungsnotwendigkeiten, die ihrerseits Konsequenz von Entscheidungen sind und absehbar weitere Entscheidungen nach sich ziehen werden, verlangt neue Formen dynamischer, nicht mehr struktureller, geschweige denn ontologischer, weltgegebener Stabilität. Sie führt zum Entstehen und zur gesellschaftsweiten Ausdehnung der Wahrnehmung von Risiken, so daß man die moderne Gesellschaft nicht nur als "Informationsgesellschaft" sondern, komplementär dazu, auch als "Risikogesellschaft" bezeichnet. Außerdem hat diese Erweiterung der Bedeutung von Entscheidungen den Sinn von "Partizipation" geändert. Teilnahme heißt jetzt: Einfluß auf Entscheidungen haben und nicht mehr: seinen Platz in einem größeren Ganzen finden." [58].

In Luhmann's conception the difference between information and knowledge is highly unclear. His conception is not useful for describing the transformations of society during the last decades as the emergence of an information or knowledge-based society because for him decisions are more important than knowledge, hence he would have to speak of a „decision-based society", and he considers modern society (as well as some premodern societies) generally as an information society because decisions would be characteristic for modern society and decisions would require information.

All societies are based on human activity that produces subjective and objective knowledge. But nonetheless we don't 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 realms. The emergence of the knowledge-based society is a multidimensional shift that involves the rise of knowledge as strategic resource in all societal areas. Knowledge has become besides labour, capital, property, and power 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, knowledge products. The first phase of capitalist development was based on extensive technological development, the quantity of technology, labour, and capital applied in the production process was steadily increased, but technology only changed slowly. In knowledge-based capitalism there is an intensive technological development that is based on a series of fast qualitative technological innovations.

Like letters, books, television, radio, telephone, telefax, telegraph, etc. the computer is a knowledge-based technology or medium. The specific feature of the computer is that it enables the convergence of traditional media in one digital medium, knowledge-representation in the computer can combine written text, spoken words, audio, video, and animations in one single 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. Traditional machines as well as the computer are objectifications 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 of humans, a sort of supraterritoriality, time-space compression, action at a distance, and accelerating interdependence [43, 44, 1999, 75, 79]. Knowledge is today quite substantially detached from territorial space, it cannot be situated at 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 in the sense of the generation of spatial and temporal distance. One of the main characteristics of knowledge-based technologies is that they increase the speed of delivery of data massively and hence are a medium of the time-space distanciation of communication. They contribute to the disembedding and delocalization of social systems and relationships and hence reshape society. But they also further the reeembedding and localization of disembedded social relationships, e.g. the globally available information on the Internet is embedded into local cultural contexts of action by the recipients.

The 20th century has seen an unprecedented increase in intensity, extensity, and velocity of global communication that is closely related to the rise of radio, television, satellite transmission, 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 not much at all in comparison to the telephone [53: p. 80]. This doesn't imply that technological globalization is a myth, but that we should also stress 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 decontextualization and derealization of communication, implications of computer mediated communicated for the formation of identities, etc.

The common theme underlying Giddens' concept of disembedding [43], Castells' concepts of timeless time and spaceless space [13-17], and Harvey's [44] concept of time-space compression is that modern society requires new technologies and forms of organization that accelerate and flexiblize production in order to function. Hence the history of capitalism is a history of globalization and of the technological acceleration of transportation (of data, capital, commodities, people) that makes the world a smaller place in the sense that it increasingly mediates social relationships more efficiently so that it appears like distances are disappearing. Technological progress has resulted in an increasing separation of the movements of information from those of its carriers, the movement of information gathered speed on a pace much faster than the travel of bodies [4: p. 14]. Bauman is right in emphasising that this today is a stratifying form of mobility where unprecedented freedom from physical obstacles and ability to act from a distance can only be enjoyed by some.

We today 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 [28]. The antagonisms are an expression of the fact that with the increased knowledge-based character of society, there is an increase of both fragility and problem-solving capacities. Knowledge is today besides capital, power, and labour 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 with a set of social antagonisms: a technological anatagonism 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 spread by the Internet [28, 38, 39].

By entering the knowledge age, we face both great opportunities and risks. Hence knowledge-based society requires an ethical dimension of knowledge, ethical knowledge should be constructed in order to provide guidelines to actions that show which paths of development are desirable and which ones should be avoided. Social development can't be steered because society is a complex, self-organizing system, but this doesn't mean that we are facing all-determining social structures that can't be shaped. Human agency can increase the possibility that certain developments will be realized and that others won't 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 of 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 [25]. The main task of the KBS is to solve the global social problems. In a KBS that is dominated by competition, heteronomy, and exclusion, these problems won't 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 [94]. The increased influence of scientific-technological knowledge on our lives has resulted in an increased fragility of society and nature [81]. Risks arise a side-effects of a form of modernization that is "blind and deaf to […] [its] own effects and threats" [6: 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 [7: p. 1996]. The more modern a society, the more knowledge-based and risk-intensive it would become [8]. There would be two forms of non-knowledge: something that one doesn't want to know (Nicht-Wissen-Wollen) and something that one can't know (Nicht-Wissen-Können) [8: 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 non-knowledge, learning to know that and what one can't know and avoiding not wanting to know [8: 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" [9: p. 266]. Only through external knowledge one could become aware of the threats one is facing (e.g. that your daily cup of tea contains DDT) [9]. Those who are affected of 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 (ibid.). Beck argues that there is no scientific monopoly of knowledge about risks because science and

technology would themselves produce a great deal of risks [9]. Risk society would demand a reorganization of power and responsibility towards a participatory democracy that includes public risk awareness and consciousness [9]. 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.

Heinz Von Foerster [85] has pointed out that knowledge (in German *Wissen*) requires conscience (in German *Gewissen*). This would be very pressing because society would be facing a 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" [85: p. 173]. This is an indication that ethical knowledge is a fundamental foundation of a sustainable and participatory knowledge-based society.

In order to exist and to produce reality, humans depend on each other, humans can only exist as social beings. Hence the social character of the human being is an essential quality of human existence. Humans need to communicate and to co-operate in order to exist and to produce and reproduce the foundations of their existence. One can't imagine a society without co-operation, but one can still speak of a society when negative qualities such as competition, war, exploitation are not present. Hence co-operation seems to be a more essential quality of society than competition. Modern society is a competitive society and hence the existence of society in modern society is estranged from the co-operative essence of society. Strengthening participation and co-operation can be a strategy for solving the global problems that today threaten the further existence of mankind and brings society closer to the realization of its essence. 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. Only a co-operative and participatory knowledge-based society will be a wise knowledge-based society that can solve the global problems.

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