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ICTs and Society: The Salzburg Approach

Towards a Theory for, about, and by means of the Information Society

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ABSTRACT

There is an international debate revolving around the question whether or not the field of overlapping studies and research in Internet, Information Society, ICTs and Society, Social Informatics, Informatik und Gesellschaft, New Media, and the like, is or shall become a discipline. The answer the authors of this paper intend to give is that the best option for research in ICTs and society is to become a "transdiscipline".

The paper will explain how the term "transdiscipline" can be used to characterise a field shaped to meet what the authors think contemporary society is in need of. Aims, scope, and tools of ICTs and society research will be elaborated on.

This paper is a revised version of a paper three of us presented at the IR 7.0: Internet Convergences, a conference held by the Association of Internet Researchers in Brisbane, Australia, in September 2006.

KEYWORDS:

ICTs, Internet, Social Software, Web 2.0, Transdisciplinarity, Complexity, Critical Theory

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1 INTRODUCTION

In the course of the last ten years there has been a shift in the field of Science–Technology–Society or Science & Technology Studies towards more and more recognition of the role the so-called modern information and communication technologies (ICTs) play for the advent of Information Society (or whatever term may be used to depict the society to come that is said to deeply depend on the usage of ICTs) and a field named in different variations, like IT (information technology) and society, Internet Research, Information Society Studies, Social Informatics, New Media Studies, and so on, has emerged and has been given infrastructure by the establishment of a variety of research centers which specialise in the relationship of "ICTs and Society" as we propose to call the whole field. So, in parallel with other initiatives around the world, the University of Salzburg, Austria, decided to establish the Center for Advanced Studies and Research in ICTs and Society, which has been at work now since 2004.

It is clear that this field is in a premature state-of-the-art. So the body of theories seems not yet elaborated. Kim and Weaver (2002) published a comprehensive study on Internet Research. They found out, that there is a large number of empirical studies about the Internet in terms of content and audience research as well as traditional approaches deriving from mass communications. New theoretical investigations however are lacking.

The international debate is revolving around the question whether or not this field

- has already arrived at, or is directed towards becoming, a discipline,
- is or shall become an interdiscipline,
- is or shall remain an "indiscipline",
- or shall become a "transdiscipline"[1].

The answer we intend to give is that the best option for research in ICTs and Society is to become a "transdiscipline".

The aim of our paper hence is to apply theoretical investigations and general works on transdisciplinarity to this research field. We further apply our theoretical investigations on a certain emerging techno-social field, namely Web 2.0 (and/or Social Software).

Web 2.0 and Social Software are notions – not yet commonly defined, but used by media, researchers and users. What is suggested in both academic and non-

[1] This issue has been discussed in Volume 21, No. 4 of *Information Society* (September-October 2005).

scientific debates around this topic is a new phase of the web that leaves behind static hypertext websites and ushers in new possibilities for knowledge management, e-learning and general knowledge technologies, and for virtual communities to form. Users are now designers and active contributors in innumerable communities, blogs and wikis. As *produsers* they generate content by aggregating, mashing-up, (re) interpreting and distributing information. Web 2.0 and Social Software require transdisciplinary approaches, as later will become even more clear.

We start with a chapter on transdisciplinarity in general, continue with a chapter on historical attempts to pave the way for a science of the Information Society by developing several theoretical frameworks, and conclude with a sketch of how ICTs and Society can be framed as a critical transdiscipline.

2 TRANSDISCIPLINE

By the term *transdiscipline* we mean something distinct from the term *inter*-discipline. This in two respects: first in the respect of the *scientific status* and second in the respect of the *societal function*.

2.1 Scientific Status

First, as regards the *scientific status of the field*, the concept of a transdiscipline does not mean a mere combination of existing disciplines – in the case of "ICT and society" a mere combination of technology and social science –, but a *transgression* of the traditional borders of the participating disciplines and thereby a transformation of the disciplines into something new which has its own identity insofar as it disposes of its own terminology overarching the terminologies of the single disciplines it departs from.

A transdiscipline therefore is expected to bridge several gaps: the gap between the two cultures of (natural) science and social and human sciences as well as the gap between specialists and generalists as well as the gap between applied research and basic research. And it is the result of a process that departs from mono- or multidisciplinarity and transcends interdisciplinarity.

2.1.1 The Two Cultures: Bridging the Gap between Science and Humanities

First, we can identify a gap between the natural and the engineering sciences on the one hand and the arts and humanities (including the social sciences) on the other hand. All of these distinctions are the result of a paradigm shift, which dates back to the 17th century and to philosophers such as René Descartes and Francis Bacon. The rise of analytical approaches, empiricism and rationalism marks a change of scientific methods (see Hofkirchner 2002, 219pp).

The gap between the two branches in science reached its heights in the late 19th century with the works of philosophers, scientists, and literary intellectuals such as Wilhelm Windelband, Heinrich Rickert, or Wilhelm Dilthey in German speaking countries or Thomas Henry Huxley, and Matthew Arnold in Great Britain. Wilhelm Windelband for example, who introduced the disjunction between *nomothetic* (meaning: the law) and *ideographic* (meaning: the event), closed his famous lecture *History and*

Sciences with the words: "The law and the event remain to exist alongside one another as the final, incommensurable forms of our notions about the world" (Windelband 1894, translated by Mos 1998). Also in the 1880ies T.H. Huxley and Matthew Arnold had a controversy about the relation between scientists and literary intellectuals. For T.H. Huxley, a biologist who taught Darwinian Evolution Theory, the natural sciences were more important than any other discipline within the arts and humanities because for him culture was nothing but nature. In his lecture "Science and Culture" T.H. Huxley said: "Mr. Arnold tells us that the meaning of culture is 'to know the best that has been thought and said in the world.' [... But...] culture certainly means something quite different from learning or technical skill" (Huxley 1880, online). Matthew Arnold, one of the leading literates and intellectuals in Victorian England, was convinced that culture means something else than nature. For him it was more important to have at least some knowledge of Greek, Roman, and Eastern Antiquity (see Arnold 1882, online).

In the late 1950ies Snow reflected the Two Cultures in science. For him it was dangerous to have two cultures, which are not able or willing to communicate. "In a time when science is determining much of our destiny [...] it is dangerous in the most practical terms. Scientists can give bad advice and decision-makers can't know whether it is good or bad" (Snow 1998a, 98). The solution to such a dangerous distinctions should be a "third culture", as Snow pointed out in his second essay "The Two Cultures: A Second Look", which was published in 1963. Snow's second essay ends with the words: "With good fortune, however, we can educate a large proportion of our better minds so that they are not ignorant of imaginative experience, both in the arts and in science, nor ignorant either of the endowments of applied science, of the remediable suffering of most of their fellow humans, and of the responsibilities which, once they are seen, cannot be denied" (Snow 1998b, 100).

The notion of the Third Culture is very popular in today's scientific world. John Brockman, a US-American publisher and author, used this term as the title of his anthology "The Third Culture – Beyond the Scientific Revolution" (1995), in which he refers to Snow's Third Culture: "Although I borrow Snow's phrase, it does not describe the third culture he predicted" (Brockman 1995, 18). Whereas Snow demanded a culture in which scientists and literary intellectuals were able and willing to communicate with each other, Brockman's "third-culture thinkers are the new public intellectuals", who are "communicating their thoughts to the public and to one another" (Brockman 1995, 18 and 20). The Third Culture is according to Brockman "founded on the realization of the import of complexity, of evolution. Very complex systems – whether organisms, brains, the biosphere, or the universe itself – were not constructed by design: all have evolved" (Brockman 1995, 20-21). Brockman's attempt is not sufficient for the concept of an emerging Third Culture, as he is only referring to "scientists and other thinkers in the empirical world" (Brockman 1995, 19). He fosters the distinction between the natural sciences and the humanities by only considering sciences that employ analytical and empirical methods.

For some researchers the Third Culture means disciplines that cannot be classified as either belonging to the natural science or to the humanities. E.g. Wolf Lepenies (2002) argues in such a way; he sees sociology as a mediating science, the social

sciences as disciplines located between the natural sciences and the humanities – they are considered to bridge the divide between these two branches.

However, most of the introduced notions of the Third Culture are too simple. Traditional scientific approaches tend to be dualistic – the two scientific branches appear to be incompatible and incommensurable –, or they are monistic – either the natural and the engineering sciences or the humanities or the social sciences are considered as problem-solving approaches only. In a true transdiscipline, both sides are considered as forming a differentiated unity: the natural sciences as well as the humanities, the scientists as well as the literary intellectuals and philosophers are immanently connected to each other without loosing their own identity, but changing each other mutually (see Raffl 2006, 320).

2.1.2 The T-Problem in Science: Bridging the Gap between Specialists and Generalists

Second, it often seems that there is a divide between specialists and generalists. some point out that specialists and experts are digging deeper and deeper for knowledge in one specific discipline, and that they are not able to see a greater whole. On the other hand there are philosophers and generalists who ought to have broad knowledge about many different topics, but no deeper understanding of real world problems. Whenever we talk about broad and general knowledge we are always facing the prejudice that general and deep knowledge would be incompatible (see Laszlo 1998, 12).

We can say that some may know more and more about less, whereas others know less and less about more. Hence a new knowledge is required, a knowledge that might take thinking on a more collaborative level into consideration (see Raffl 2006, 318). That is what a transdiscipline is to be about.

2.1.3 Pasteur's Quadrant: Bridging the Gap between Basic and Applied Research

Third, we can furthermore identify a gap between pure basic (grounded) research and applied research – a distinction between theoretical investigation/exploration and practical applications.

In 1997 Donald Stokes published the essay "Pasteur's Quadrant", in which he discussed the relationship between pure and applied research, especially in terms of technological innovation. "The belief that the goals of *understanding* and *use* are inherently in conflict, and that the categories of basic and applied research are necessarily separate, is itself in tension with the actual experience of science" (Stokes 1997, 12). Stokes strives to sublate the dyadic research system, because in his opinion there are huge areas of research that simply cannot be classified as *either* basic, *or* applied research, hence these branches shall not be divided. This integrative aspect, whereby *good* research is both, pure basically and practically ap-

plicable, can according to Stokes seen combined in the researcher Louis Pasteur. Stokes exemplifies his ideas of research in the model below, the "Pasteur's Quadrant" (see Figure 1):

	Consideration of Use?		
		NO	YES
Quest for fundamental Understanding?	YES	Pure Basic Research (Bohr)	Use-Inspired Basic Research (Pasteur)
	NO		Pure Applied Research (Edison)

Figure 1: "Quadrant Model of Scientific Research" (see Stokes 1997, 73).

Pure Basic Research in the upper-left cell refers to grounded research with the primary quest for fundamental understanding; this can – according to Donald Stokes - be exemplified with the physicist Niels Bohr: "Niels Bohr's quest of a model atomic structure was a pure voyage of discovery" (Stokes 1997, 73). The right cell below refers to the kind of research that is (more or less) targeted to concrete application and production without gaining a deeper understanding for basic questions; this type of research – dedicated to Thomas Edison – is "[...] extremely sophisticated, although narrowly targeted on immediate applied goals" (Stokes 1997, 74). The left cell below is in reality *not* empty. It is drawn upon research that is neither basic, nor applied: "This quadrant includes research that systematically explores *particular* phenomena without having in view either general explanatory objectives or any applied use [...]" (Stokes 1997, 74). Stokes mentions private interest in ornithology as an example for this kind of research. The heart of this model can be found in the upper right cell, which Stokes dedicates to the chemist Louis Pasteur: "The upper right-hand cell includes basic research that seeks to extend the frontiers of understanding but is also inspired by consideration of use" (Stokes 1997, 74).

Also Juergen Mittelstraß addresses this problem. He points out that contemporary research builds a triangular model assembled by pure basic research, application oriented basic research and product-oriented applied research (see Figure 2). Hence the dualism between basic and applied research has – according to Mittelstraß – already become obsolete (see Mittelstraß 2001, 48-49). Research on stem cells for example is according to Mittelstraß both, basic research because it is a rather young discipline and not much knowledge has already been gained, and applied research because it is product-oriented research (see Mittelstraß 1992, 63).

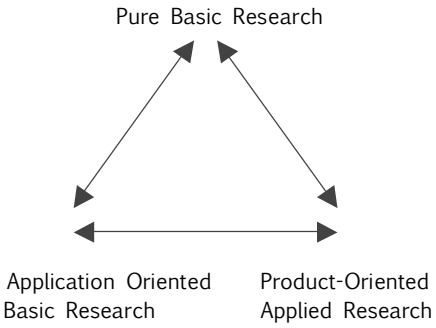

Figure 2: Triangular Model of Research

Use-inspired or application-oriented basic research is a core property of a transdiscipline.

2.1.4 From Mono- and Multidisciplinarity to Interdisciplinarity to Transdisciplinarity

Multidisciplinarity is a pluralistic worldview, the result of a dualistic Two-Cultures-thinking. Binary thinking has resulted in a fragmentation into various disciplines and institutes. The sum of several disciplines, where each discipline uses its own objectives, objects, methods and theories is according to Eberhard von Goldammer and Rudolf Kaehr called multidisciplinarity (see Goldammer and Kaehr 1996, online). There is no interaction between disciplines, they are fragmented and have nothing in common. Each branch tries to solve problems within its natural, i.e. historical grown, boundary by using its own methods and speaking its own disciplinary language. In multidisciplinary research projects scientists from different disciplines are trying to find a solution to the same problem, but their research is fragmented and not integrated in one joint project, they are not working cooperatively, but in coexistence only (see Raffl 2006, 321).

While multidisciplinarity means to add one discipline to another, each of them solving the problem from another standpoint, or "washing their own laundry" as John Brockman tends to call it popularly (Brockman 1995, 19), interdisciplinarity means to solve one specific problem in a joint project, but by still using methods and theories and speaking the language of different disciplines. There is also an accumulation of many disciplines that exist independently from another; there is not much interaction of researchers with diverse backgrounds. Researchers from different disciplines are working on one shared common problem by using their "home-methods" and theories. When the project is finished (and in the best case the problem is solved), scientists go back to the institutes they originally came from. There are no durable effects of such a type of research. Therefore interdisciplinarity is more appropriate for short-term projects and more suitable for teaching and education than for scientific research (Raffl 2006, 321).

Though as with the terms multi- and interdisciplinarity no unified understanding of transdisciplinarity can be found in scientific literature, it makes sense to make a distinction. For Jeremy Hunsinger "transdisciplinary research attempts to approach the object of study beyond and across disciplinary and interdisciplinary perspectives" (Hunsinger 2005, 277). Transdisciplinarity increases the chance of a dialogue and mutual understanding, as well as an exchange of knowledge and information. Furthermore "a transdisciplinary field is one defined by the globality of its object of study, combined with the complex, emergent, and changing nature of that object" (Hunsinger 2005, 277). For Julie Thompson Klein transdisciplinarity is a new principle of research that has emerged together with new global problems and has resulted in social, political, and cultural changes. Due to the global aspect of these problems, they cannot be solved with theories and methods from one specific discipline only.

Transdisciplinarity does not mean to dissolve disciplinary competences: "Transdisciplinary research is an additional type within the spectrum of research and coexists with traditional monodisciplinary research" (Häberli and Thompson Klein 2002, 4). Traditional ways of research shall not be substituted by transdisciplinarity; furthermore this new type of research requires both the specialist and the generalist (see Bill et al. 2002, 32). According to Juergen Mittelstraß transdisciplinarity means long-term cooperation that changes disciplinary orientations. Transdisciplinarity is an integrative, but not a holistic concept. Disciplinary isolations are therefore suspended on a higher methodological level, as transdisciplinarity goes beyond specialization, but without substituting disciplines (see Mittelstraß 1994, 50).

2.2 Societal Function

Second, as regards the *societal function of science*, the concept of a transdiscipline does not adhere to the long held assumption of science being in an ivory tower, but implies a transgression from the scientists to the stakeholders affected by the results of research and a transformation into a new science that is human-centred, democratic, participatory.

Stakeholders play a very important role also in this new perspective of scientific research and cooperation: "Transdisciplinary knowledge, because it has been recontextualized for the broader audience of multiple disciplines, is more accessible and interpretable" (Hunsinger 2005, 278). For Charles Kleiber, transdisciplinarity means the "pooling of disciplinary knowledge and information, technological revolutions, and the creation of networks and new forms of knowledge" (Kleiber 2002, 56). Due to the global aspect of the problems to be solved, they cannot be solved by single persons or groups, i.e. by scientists alone: "Other parts of society must be involved as well, including industry, business, public administration, and non-governmental organizations [...]" (Häberli and Thompson Klein 2002, 8). Helga Nowotny and Michael Gibbons point out that because "knowledge is transgressive, [...] transdisciplinarity does not respect institutional boundaries" (Gibbons and Nowotny 2002, 70). Furthermore transdisciplinarity crosses national boundaries, it is a transnational concept. Hence transdisciplinarity means more than just a sum of researchers from

different disciplines working together, as within multi- or interdisciplinarity. Transdisciplinarity crosses academic boundaries in order to solve real-world problems. Universities and other research organizations have to be(come) open-minded and willing to cooperate with non-academics as well as with scientists from other disciplines. In this understanding "both partners can learn from each other: Collaboration in a transdisciplinary research project requires partners from practice to open their horizons, [...] developing new products to position themselves on the market. For participants from science, collaboration results in new views and ideas, better understanding the real world and testing and adapting of their theories [...]" (Häberli and Thompson Klein 2002, 16).

Helga Nowotny calls this cooperation with non-academics "Mode-2" (in opposition to Mode-1 that signifies traditional disciplinary research); different types of agents or stakeholders play a very important role from the very beginning of research projects until they are finished – and even after (see Nowotny 2001, online; Gibbons and Nowotny 2002, 69pp). In this perspective it is a necessity to foster teamwork. "No single human being possesses all the knowledge required [because] it is not possible to be good in everything. But, everyone can learn to work together through networking" (Bill et al. 2002, 28 and 32). Nowotny and Gibbons explain: "What we are trying to convey by the notion of transdisciplinarity is that, in Mode-2, a forum or platform is generated and it provides a distinctive focus for intellectual endeavour, and it may be quite different from the traditional disciplinary structure" (Gibbons and Nowotny 2002, 69). Mode-2 takes the new societal position of science into account as it requires the "management of complexity in a public space, which is neither state, nor market, neither public, nor private, but all of this in different configurations" (Nowotny 2001, online).

3 Rationale for and Historical Advances Towards Shaping the Field: Technological, Social-Scientific, and Cross-Disciplinary Accounts

Research in ICTs and Society forms the core of a science of the Information Society.

3.1 The Problematique

On the one hand not only the most industrialised countries, but also less developed countries, are subject to transformation processes in the sphere of the technological organisation of society, due to the development and diffusion of modern technologies which are supported and furthered by national and regional policies which set up a tremendous number of technology-advancement programmes. These policies are still confined to a view that looks upon technology as an independent factor of societal development.

On the other hand there has been growing awareness that technological determinism is too myopic, since the belief in technological progress which *per se* entails social progress has diminished. Development in technology is not accompanied by an equally rapid growth in scientific insight, let alone foresight, as to the impacts of technology on levels of society other than that of technological organization. Attempts to observe and understand the basic nature of this change are still second place. The public use of the notion of "Information Society" has been reduced to denoting a society in which applications of modern information and communication technologies are widely spread in order to facilitate the handling of entity-like "information". Data, however, is not the *ultima ratio* of this new society to come, nor even is knowledge, regardless of its quantity, as the recently EU-wide hype of knowledge-based economy and society suggests. It is wisdom which may make the emerging society a "wise society" (see the report of the HLEG 1997) that is capable of coping with challenges arising from its own development. A scientific understanding of this new form of society has not had time to develop. There is not yet a "science of the Information Society". Nevertheless, it seems an idea whose time has come.

3.2 Shaping a Future Science of the Information Society

There are three criterions along which each scientific endeavour can be assessed: aims, scope, and tools. *Aims* means that each research has a certain task to fulfil, namely, to contribute to solving problems arising from practice. *Scope* refers to the domain, that is, the constitution of the object of investigation led by theoretical deliberation. And *tools* denote the ways and means of the approach, to wit, the methods used to mediate between empirical data and theories.

According to that, a future science of the Information Society may be characterised in the way we discuss in the following subchapters.

3.2.1 Aims of a Science of the Information Society

As to the first criterion, a science of the Information Society would have to serve the practical purpose of meeting the demand for governance which has been rising exorbitantly. This is because the gap between the necessity to tackle global problematics (which sets at risk the survival of humanity) and the (im)possibility of acting in face of tendencies of fragmentation, heterogenization and desintegration, has been widening. Attempting to come to grips with these problems is not possible without trying to steer society, for these very problems turn out to be basically problems of governing of society in that the old forms of control and regulation have proven obsolescent, and so new forms are needed. That is, a science of the Information Society should provide society with a means of enhancing its problem-solving capacity regarding the challenges it is confronted with. Thus, a science *of* the Information Society is a science *for* Information Society – for guiding society in coping with the problems of the global information age.

3.2.2 Scope of a Science of the Information Society

Coming to the second criterion, theorising the underlying processes and structures of all malfunctions in the sociosphere, ecosphere and technosphere that continue to aggravate the global challenges belongs to the domain of a science of the Information Society. Insofar as disparities in the development of the relations amongst humans, between humans and nature and between humans and technology build obstacles to keeping society as a whole on a stable, steady path of development, they constitute the very object of inquiry. A science *of* the Information Society is, hence, a science *about* Information Society – about the causes of today's societal crises and how to remove them.

3.2.3 Tools of a Science of the Information Society

And since the investigation has to comprise as wide a range of matter as this, a science of the Information Society cannot, with reference to the third criterion, afford to neglect any methodological means of study which might be fruitful and elucidating. Likewise it must not fail in putting the puzzle of findings together and in synthesising the manifold analyses, thus transcending the borders of disciplines and aiming at the unity of science by a unifying approach without subjecting any thinking to uniformity. In that sense, a science *of* the Information Society is a science *by means of* Information Society – by means of making use of possibilities technologies of knowledge provide for getting access to, comparing and assessing an ever increasing variety of knowledge.

3.3 Forerunners of a Science of the Information Society

Historically, there are two main lines of scientific discussion, which are gradually becoming intertwined and may serve as a starting point for elaborating on a science for, about, and by means of, Information Society. First, there are a number of social theories which focus on diverse aspects of the emerging society. Second, it is no surprise that the so-called information theory and its development are also important in this context, for the concept of information is related to the concept of Information Society.

3.3.1 Disciplinary Accounts

The social-scientific accounts can be classified as follows: On the one hand, the historically earliest theories were those which offered an *evolutionary* perspective within a framework of theories of history like Tadeo Umesao's one in 1963, who postulated stages from agricultural production to material industry to information industry; McLuhan (1967) took for granted that by "an extension of the nervous system itself ... with circuitry" the Neolithic age gives way to an "electric age", and Brzezinski (1968) spoke of a "technotronic age", both having computers and communication technologies in mind; these theories are often formulated either in terms of the so-called "scientific-technological revolution" mainly in socialist countries (the famous Richta Report in 1966) or in oppositon to Marx's thinking (Bell 1973, later followed by Toffler 1980), but all of them have a bias to technological determinism.

On the other hand, there have been a number of generalisations of empirical findings and attempts to identify trends in societal development which were supposed to mark a qualitative change.

The most famous approaches are trials to highlight changes in the structure of *economy* and in the division of labour which assume the emergence of an information sector and of information workers (Machlup 1962, Porat 1976, OECD/ICCP 1981, OECD/ICCP 1985); a Japanese approach measures the information consump-

tion in terms of percentage of costs in a household budget, which is called the information coefficient (see Ito 1980 and 1987).

These economic analyses are supported and supplemented by studies and essays in *culture* which deal with cognitive or communicative aspects; some of them state that knowledge has become, or is becoming, the key factor not only in economy (where it outweighs capital and labour) but also in other realms of society, so that it seems justified to speak of the coming of a knowledge society (e.g. Drucker 1969 and 1993, Stehr 1994) or (with respect to the important role scientific knowledge has begun to play) of a "Wissenschaftsgesellschaft" (Kreibich 1986), or (with respect to the tremendous efforts to govern this new factor) of a society which is in need of a knowledge order as an analogue to its economic order (see Spinner 1994) or (with respect to changes in cognition due to the virtual reality) of a cyber-society (e.g. Bühl 1996); another part of them shifts attention to communication processes (see Münch 1991, 1995) for which in 1969 the Japanese Association for Economic Planning developed the information flow census as measurement (see Ito 1987).

A third category of information-society concepts may be called critical, insofar as they lay emphasis on *political* factors like interests which they claim to be camouflaged by pretended technological constraints (see Touraine 1969, Lyon 1988, Webster 1995).

Besides these attempts to take into account social factors, the focus of a fourth approach has from the very beginning been to emphasize *technological* trends; the Research Institute of Telecommunications and Economics (RITE) in Tokyo tried to compile an "informatisation" index made up of several measurements of the media infrastructure of society (see Hensel 1990), a turn which was introduced in Europe by the French report by Nora and Minc (1978).

However, a synoptic look was not achieved within this lineage.

3.3.2 Cross-Disciplinary Accounts

Cross-disciplinary accounts revolving around the *information* concept are of importance too, here. Whilst at the end of the last World War the concept of information was still seen largely from a limited and one-sided military viewpoint, scientific debate on the topic has since then been dominated by attempts to move away from these limitations and see the subject in a different way. Shannon's syntactic definition of 1948 was thus followed by attempts to formulate a semantically based term (most notably by Bar-Hillel and Carnap 1953) and, after that, a pragmatically based term (of which Weizsäcker is seen as the most prominent proponent (1973, 1974, 1985). Thus there has been a search for a concept which can integrate the various aspects of information processes, include the useful findings of the old term as a special case, and extend the old information theory into a new, universal theory.

Conceptualisations which date from the second half of the 1980s mark a new period in which the interrelations and interconnectedness of these two lineages came to the front. These are:

- the hypothesis of the control revolution by which James R. Beniger (1986) draws parallels between the breakthrough to the Information Society and former revolutions in the course of life and culture; and
- the hypothesis of the evolution of information-processing systems put forward by Klaus Haefner in 1988 (and edited in 1992b, see also 1992a) which makes the Information Society the ultimate result of the evolution of systems in the universe which are capable of generating and processing ever higher information.

These two outstanding contributions are the initial steps towards a single and comprehensive science of – that is, for, about and by means of – the Information Society.

Writings of scholars who do not have a sociological but rather a cross-disciplinary background build upon the same train of thought: the three-volume work of the Dutch expert in International Relations, Johan K. De Vree (1990), who develops a system-theoretical approach, starting with thermodynamical considerations, and by doing so avoids the fundamental shortcoming of cutting society free from the material-energetic world (a mistake which Luhmann makes), has to be mentioned here, as well as the information-science trilogy written by Tom Stonier (1990, 1992, 1995), a biologist and, finally, before he passed way, Professor Emeritus for science and society at the University of Bradford, who offers an evolutionary perspective of societal development up to the information age. Both of them had been active in the Foundations of Information Science community when it started a decade ago. In addition there are several approaches which aim at theories of a global brain (e.g. the Principia Cybernetica Project group around Francis Heylighen, see for instance 1995 or 1997, from a cybernetics point of view) or a collective intelligence (Lévy 1997 – in French 1994 –, from a philosophical point of view) or draw parallels between super-organisms and mankind (Stock 1993) or between biotic and cultural developments in general (see e.g. the living systems theory of James Grier Miller from 1978 and the article Miller and Miller 1992 or Peter Corning's Synergism Hypothesis from 1983) or share an evolutionary perspective without referring to biology (e.g. Malaska 1991, Artigiani 1991).

4 ICTs & Society: A Critical Transdiscipline

While there is a lasting trend towards transdisciplinarity in theorising the complexity of science and technology in the information age, empirical research in that field so far seems to make use of a mixture of multiple approaches which is characteristic of a multi- or interdisciplinary stage of evolution. By the same token, this character makes the field of ICT-and-Society research ready for going transdisciplinary. What is needed is the taking-up of the theoretical trend by empirical research.

This is what we attempt to do in the Paris Lodron University of Salzburg priority programme in Information and Communication Technologies & Society (ICT&S). It lays emphasis on the *integrative assessment as well as design of both Information and Communication Technologies (ICTs) and their social context*.

- It develops both technological prototypes and policy recommendations for the implementation of ICTs for business, government, and civil society organisations, and, by including the users, the stakeholders, it is transdisciplinary from the outset.
- It researches the design of ICTs as well as the design of the full range of societal (cultural, political, economic, and, besides social, ecological as well as technological other than information-technological) conditions of their implementation. It focuses on several trends of emerging ICTs that inhere a potential for networking individuals, organisations, and societies so as to include all and promote convergence and cohesion by improving participation, cooperation, collective intelligence and conflict resolution in the information age. At the same time, it focuses on several societal contexts that foster or dampen the actualisation of the potential of the ICTs.
- It crosses the perspectives of engineering and social sciences and humanities and even other disciplines if appropriate. It tries to ground empirical research concerning the assessment of ICTs and their implementation in theoretical considerations and contributes to elaborating on the body of theories in the internationally emerging field of ICTs and society by combining information-technological and social design with empirical findings. In particular, the core of the methodology applied at the Salzburg ICT&S Center integrates three different strands of thought: New Media Studies with background in Communication Science, Human Computer Interaction with background in Computer Science, and Information Society Research with background in Sociology of Technology.

Framed this way, it becomes clear that ICT&S Research in our sense serves the function of a critical science. All science wants to be critical, but in many cases the category of criticism is used either in the sense of inner-scientific questioning and learning (in the tradition of Popper's Critical Rationalism) or in the sense of asking in a Socratic dialogue. Sonia Livingstone (2005) argues that in Internet Studies one

finds three levels of critique: analytical critique that is sceptical of claims for novelty, explanatory critique that grasps the mutual shaping of technology and society, and ideological critique that contests dominant world views and argues for change for the better. A critical theory thus is a theory that contains a certain standpoint. Sandra Harding, resuming the famous notion of critique Karl Marx laid out in the "Introduction to the Critique of Hegel's Philosophy of Right" that grasps "the root of the matter" and is based on the "*categoric imperative to overthrow all relations* in which man is a debased, enslaved, abandoned, despicable essence" (Marx 1844, 385), has coined the notion of strong objectivity, which means to "start thought from marginal lives" (Harding 1992, 581), to start "from the activities of those who are necessarily disadvantaged in a particular kind of social order" (Harding 1992, 584) and to "generate scientific problems" "not from the priorities of funders or dominant policy groups, but from outside these conceptual frameworks, namely from the lives of marginalized people" (Harding 1992, 582). Based on such a notion, critical ICT&S Research can be conceived as identifying and analysing antagonisms in the relationship of Internet and society, it shows how the Internet is shaped and shapes the colliding forces of competition and cooperation, it is oriented on showing how domination and exploitation are structured and do structure the Internet and on how class formation and potential class struggles are technologically mediated, it identifies Internet-supported not-yet realised potentials of societal development and it radically questions structures that restrain human and societal potentials for cooperation, self-determination, participation, happiness, and self-management.

According to philosophy of science and an intensive debate in the second half of the last century originating in Europe there are three dimensions along which scientific endeavours can be characterised:

- first, each scientific endeavour fulfils the task of solving a problem that arises from practice in society;
- second, each scientific endeavour circumscribes a domain by defining or determining its object of study;
- third, each scientific endeavour uses for its investigations and deliberations methods

(so you have an end, you have a starting point, and you have a means). We again refer to these dimensions in terms of aims, scope, and tools.

The following table gives an overview of the characteristics by which we want to be guided in our research in an ideal-typical comparison to characteristics of conventional investigations into the field which are neither transdisciplinary nor critical.

	Mono-, multi- or interdisciplinary, conventional approaches to ICTs and society	Transdisciplinary, critical approach to ICTs and society	
		In general	Internet and Web studies
Aims	L'art pour l'art resp. any feasible ICT application demanded by business and/or government interests	The design of both ICTs and their social settings to suit a Global Sustainable Information Society (GSIS)	To turn the Internet into a material underpinning of global consciousness; to make the Web a "technology for cooperation"
Scope	ICTs in any context	Facilitators and inhibitors that condition the design of both ICTs and their social settings to suit a GSIS	Contradictions of the Internet; the Web anticipating a future society, while serving as instrument for competitive, partial interests prevailing in current society
Tools	Anything goes	A combination of methods that is apt to deal with facilitators and inhibitors that condition the design of both ICTs and their social settings to suit a GSIS	Analysis and synthesis of the Internet as an Evolutionary Techno-Social System; of the Web as composed of "produsers" that organise themselves by means of hard- and software into communities of practice

Table 1: Aims, scope, and tools of mono-, multi-, or interdisciplinary vs. transdisciplinary and critical research in ICTs and society.

The unity of the Salzburg Approach is, programmatically, constituted through

- the unity of the research practice that is given by defining the research practice as contributing to the design of both ICTs and their social settings to suit a *Global Sustainable Information Society* (GSIS) – a vision that departs from the most urgent problems contemporary societies are facing around the world;
- the unity of the research object that is given by defining the research object as any context that is meaningful for reaching that goal, that is, as *facilitators and inhibitors* that condition the design of both ICTs and their social settings to suit a GSIS;
- the unity of the research methodology that is given by the definition of the research methodology as a combination of methods that is apt to deal with facilitators and inhibitors that condition the design of both ICTs and their social settings to suit a GSIS, that is, as a *system of complexity sci-*

ence methods combining social and human, natural, and engineering science methods that produce knowledge of, and inform acting upon, that object of study.

As a consequence, the Internet and the Web, in particular,

- are considered a desirable good insofar as they are shapable so as to bring about the advent of the GSIS, that is, as technologies that inhere the potential of providing the glue for the world society to come, of counterbalancing the tendencies of heterogenisation, fragmentation, disintegration, by fostering cooperation, and of breaking the ground for a shared consciousness that is required by a reorganised world;
- are investigated as something ambivalent, as something embedded in the social disparities characteristic of contemporary societies and as catalyst of contradictions, as something that not only opens up a space of possibilities for future societal ordering but also is subject to today's order in which competitive, partial interests prevail;
- are not only analysed but also synthesised in thought as something that needs methods of both sides of the two science cultures, as techno-social systems that are a subcategory of social systems, as composed of "produsers" that organise themselves by means of hard- and software into communities of practice.

The quest for a science of the Information Society sets the stage for research in the interrelationship of ICTs and society.

We discuss how aims, scope, and tools of a science of the Information Society may shape ICT&S Research.

4.1 Aims

If it is the aims of an as-yet-to-be-developed science *for* the Information Society to help govern society when confronted with the well-known global challenges, it is the aims of transdisciplinary ICT-and-society research to contribute to shaping ICTs so as to help bring about a Global Sustainable Information Society (GSIS). A GSIS can be defined in a normative way and the ICTs can be assessed according to how they facilitate society to live up to these values. This is in sharp contrast to either undertaking research solely for reasons of curiosity or being instrumental to whatever is demanded by parts of society. In contrast to the ideology of value-free science, here the normatve criteria are laid down to which ICTs as well as society shall be subject. A state of future society is envisioned in which the criteria are met.

4.1.1 Not-Yet

Being critical can be ascribed to this visionary approach in that it is normative and doing justice to the factual at the same time. For it includes not only an account of the potential that is given with the actual but also an evaluation of the potential which sorts out the desired. Thus this theory embraces an ascendence from the potential given now to the actual to be established in the future as well as an ascendence from the less good now to the better then which altogether yields the Not-Yet in critical theorist Ernst Bloch's sense (see e.g. Bloch 1967) (see Fig. 3) (Hofkirchner 2007).

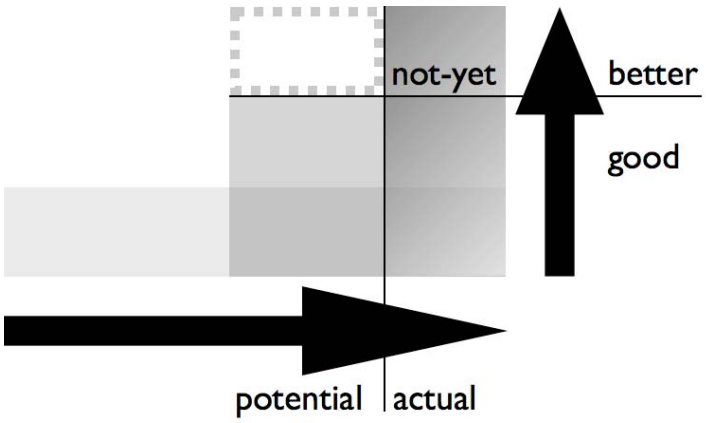

Figure 3: Not-Yet

The Not-Yet of a GSIS is conditioned by the crises civilisation is currently experiencing. And ICTs as facilitators of information processes are crucially entangled with the fate of humanity. What is so unique to information is not just the quantity of what can be conveyed by ICTs but the quantity of that is just the indication for a qualitative change taking place. There has been a qualitative change in the role information can play for the development of society, and this change is unprecedented in the history of humanity. Information has become the bearer of survival, the key to our future. For the information age is, fundamentally, the age of global challenges. It is malfunctions in the sociosphere, ecosphere and technosphere that continue to aggravate the global challenges. And it is information that turns out the only remedy. It is information that is required to steer society. It is information that is required to reorganise humanity onto a higher level of organisation. It is information that is required to alleviate and reduce the frictions in the functioning of those partitions that make up humanity from the individual to ethnicities to nations to world society, from economy to politics to culture, from society to ecology to technology, from the social realm to the biotic realm to the physical realm. In a word, the continued existence of humanity has shaped up as impossible without conscious and cautious intervention in the process of its own development including all spheres of intervention.

A standpoint theory of ICT&S shows how the two competing forces of competition and cooperation result in class formation and produce potentials for the dissolution of exploitation and oppression. It is based on the judgement that cooperation is more desirable than competition, which is just another expression for saying that structures of exploitation and oppression need to be questioned, criticised and sublated. Critical theory is interested in why there is a difference between actuality and potentiality, existence and essence, and aims at finding ways of bridging this difference. It aims at the establishment of a good society (Bradley 2006), that is, cooperative, participatory society and asks "basic moral questions of justice, equity and the public good" (Murdock and Golding 2005, 61).

4.1.2 Social Cybernetics

Thus, concerning the relationship of theory and practice, the Salzburg approach is devoted to a kind of *social cybernetics*, that is, to a kind of governance established by a feedback-loop between science and technology, on the one hand, and society, on the other, in times when the old modes of steering society have proven obsolete (see Fig. 4).

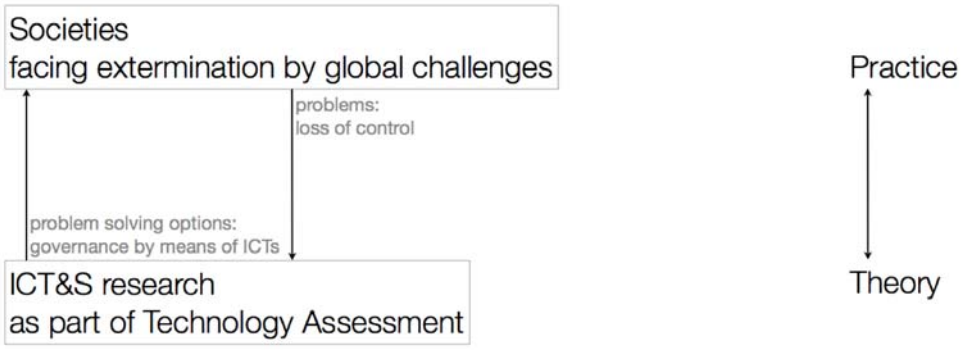

Figure 4: Social cybernetics I: starting point for the task of ICT&S Research

Science and technology ought to be reflected on a meta-level. Integrative ICT assessment and design might be the forerunner of the science of Information Society that would help maintain the GSIS (see Fig. 5). They are seen as contributors to a transition from the feedback-loop of the state-of-affairs of today to the one of tomorrow. That's the real meaning of a breakthrough to another modernity.

Figure 5: Social cybernetics II: goal of the task of ICT&S Research

Envisioning a GSIS is a complex task, since it has to find a well-balanced system of a full range of tasks that have to be taken into consideration in order to find ways out of the crises manifesting in different fields of practice.

In researching the relationship between Information Society and sustainability important results have been achieved concerning the ecological dimension (see e.g. Alakeson et al. 2003; Hilty et al. 2004a, b, 2005; Hilty and Ruddy 2000). Lorenz Hilty in this context speaks of a sustainable Information Society (Hilty et al. 2005; Hilty and Ruddy 2000). "Sustainability in the Information Society is a more recent field of research, which concentrates on the consequences of information and communication technology (ICT) for the objective of sustainable development" (Hilty et al. 2005, 38). Thus far sustainable development in the context of Information Society research has primarily been considered from the ecological perspective. A recent publication entitled "Towards a Sustainable Information Society" acknowledges that sustainability is now a multidimensional concept, but it doesn't give an explicit definition (Servaes and Carpentier 2006, 5-15). During the last decade there has been a shift from considering sustainability as a purely ecological concept to defining it in broader societal terms. Hence the discourse on ICT, knowledge, and sustainability should not halt at ecological issues (see Fuchs 2006).

A GSIS is a society, firstly, which is planetary in scale; secondly, which is collectively intelligent so as to be able to come to grips with problems that arise from its own development; and, thirdly, which is making use of modern information technologies and media in just that context and for the sake of it. That is, Information Society deserves its name only if it deploys awareness of putting itself on a path of sustainable development, and this is possible only in the global arena.

Sustainability, thus, in the sense of a state of affairs in which society is capable of assuring its own future, turns out to be the GSIS key requirement which includes a number of further requirements to be met. As to the social sphere, that is humans-humans relationship, *justice*, or fairness, is an ingredient of sustainability. A society in which unjust, or unfair, relations among humans prevail, will not be sustainable in the long run. This, in turn, includes *equality* in the cultural sphere, *freedom* in the political sphere, and *solidarity* in the economic sphere. As to the ecological sphere, that is, the relationship between humans and nature, sustainability means *harmony*

with nature which yields ecologically sound solutions. As to the technological sphere, that is, the relation of humans and technology, *humane efficiency*, namely, safety, security, usefulness and usability are values inherent in sustainability.

To be more detailed (see Hofkirchner and Fuchs 2003 and Hofkirchner and Maier-Rabler 2004), in the sociosphere social actions are carried out. Tangibles and intangible goods (be they material or immaterial) are produced and consumed. Every social being is called to co-design the collective in which the supply of the goods is provided. The more actors have access to the supply, the more the sociosphere is well-balanced, fair, just. Thus, justice is the value we can identify at the level of the sociosphere.

In this sphere the actors as social beings construe social relations concerning rules (culture), regularities (polity) and resources (economy).

Culture is about rules in society, including the regularities of political life. It is the field of discourse in which the actors can express themselves as long as they happen to gain influence by sharing the power to define values, ethics, morals (Artigiani 1991). The power of definition legitimises actors to act in a specific way. The ideal of *equality* would be fulfilled, if all cultural actors shared the same power of definition.

Politics is about power, namely, power of decision. The disposal of means of power means the ability to influence decision-making processes about circumstances of life in general including economic affairs. It represents regularities of how actors pursue interests. By resorting to power, actors are authorised to determine themselves. The more political actors have a determining influence on decisions, the more they are deemed free. Thus *freedom* is an inherent value of the political sphere.

Economy is about self-preservation of the actors through access to resources. Economy is that sphere of society where the actors carry out work in order to meet their demands. The social relationships that emerge here and channel the self-preservation of the actors are property relations – property being the disposition of resources. According to the power of disposition resources are allocated to the actors, that is, goods are distributed to them. The regulative idea for the allocation is *solidarity*.

"Ecosphere" is the label for that sphere of society that comprises the flows of matter and energy in support of the physical life of the actors. Contrary to all other forms of life on our planet, humans are able to consciously design their metabolism and to produce their *umwelt* whenever nature itself is not capable of reproducing itself for the sake of humans. *Environmental sustainability* denotes such a delicate balance between the human nature and the humanised nature. It can only be reached when the value of respect for nature scores high.

Technology is to augment the actors that take the role of productive forces in that they produce something when they aim at something. The technosphere is the sphere in which the actors of society carry out their instrumental activities. Instrumental activities are the use of technologies as well as the creation of new tech-

nologies. The overall aim to which the technological augmentation of productive forces is to contribute is to secure a *peaceful development of civilisation*.

Now, *exclusion* from activities in one of the spheres means that the respective value intrinsic to the sphere in question is not fully realised. Exclusion from activities in the sociosphere produces alienation from fellow humans, that is, the failure of not building equality in the cultural sphere leads to *lacking in influence*. The missing implementation of freedom in the political sphere generates *powerlessness*, and non-compliance with solidarity in the economic sphere is tantamount with *expropriation*. Exclusion from activities in the ecosphere results in *alienation from nature* and exclusion from activities in the technosphere yields *alienation from technology*.

Exclusiveness is a characteristic of societal relations of domination. Exclusion identifies societies in which some actors dominate other actors. The realisation of domination finds its predisposition in possible incongruencies in the interplay of individual and society. As it is in the nature of a GSIS to be inclusive, the interrelation between the individual and the society is to acknowledge their mutual enrichment. Exclusiveness denies a lasting future for society.

ICT&S as a transdisciplinary research field orients toward the fulfilment of values that are antagonists of the rule of domination. ICTs inhere the potential for that fulfilment. But they can also be used to prolong exclusions and hinder the advent of a GSIS. The inclusion of stakeholders in the genesis of technology makes the design process a participatory one and ensures a discourse that will marginalise exclusions.

4.1.3 Technology for Cooperation

Let's take the Net (the Internet and the Web) as an example (see Table 1). The normative GSIS view of Internet and society argues that the Internet today advances both opportunities and risks and that society should shape technology in such a way that it has desirable effects. What is desirable is that the Internet is networking individuals, organisations, institutions, societies at a global level and thus provides the glue by which cohesion of the emerging world society can be supported. The Internet provides the material underpinning of the consciousness that is inherent to the social system that may emerge. Eventually, its role may be that of a catalyst of global consciousness in a global society.

Actually, the Internet plays the central role in setting the stage for the above outlined vision of a GSIS as a Not-Yet. This means that the Net's basic potential and power of networking on a global level has to be transformed from a yet prevailing state of social interdependence to a non-yet state of social integration. It can be said that the ever growing density of social interconnectedness on a global scale is still mainly a quantitative phenomenon. But as Fleissner and Hofkirchner (1998) have argued, quantitative change is only a necessary but not a sufficient precondition for change in quality. Thus, the necessary qualitative step to the better (from interdependence to integration) will not simply emerge by itself, but only through

careful deployment of wise, critical, and integrative assessment and design approaches.

The Internet has to be the special target of such design practices as it is already the central digital platform where all modern ICTs are converging. In future this convergence process will only intensify further, especially with respect to the Web. Thus, the vision of a GSIS can only be achieved by carefully shaping the Net's techno-social architecture according to the above mentioned values and aims. The Salzburg Approach's way to think about this fundamental design process is to comprehend the Net as a *technology for cooperation*. In this regard, the notion of cooperation can be grasped as an abbreviation of the general GSIS-aims, but interpreted according to the special techno-social space of the Net.

Fortunately, such a comprehension of the Net as a technology for cooperation does not have to be achieved from scratch. Quite contrary, the fundamental development and early usage of the Internet as well as later of the Web has been done in a basic social spirit of code-openness, cooperation, as well as free sharing of data, information, and knowledge. The following quotation from Tim Berners-Lee's book "Weaving the Web", where he tells the story of his invention of the Web's basic architecture, gets this attitude to the point: "The web is more a social creation than a technical one. I designed it for a social effect – to help people work together – and not as technical toy. The ultimate goal of the Web is to support and improve our weblike existence in the world" (Berners-Lee 1999, 123).

In fact, it can be easily asserted that the Web as we know it today could not have come into existence, if it would not have been designed as a decentralized, modular, and open architecture of participation based on open source in the first place. The same is, of course, true for the Internet as a whole, on which the Web rests upon. The Net is based on the visionary thoughts and design actions of the "wizards" of the early Internet in the tradition of J.C.R. Licklider, who laid the most basic architecture. This was done just as well in the prospect of enhancing human communication and cooperation via computational means, leading to network design solutions that would not inhibit the future development and prospering of this architecture (what ever might come in future).

Actually, we can say that these early design solutions have been built into the Net's, respectively Web's, infrastructure, thus still expressing the spirit of the open and participative attitude of these early hackers' days. However, this has also led to the myth of an in principle uncontrollability of the Net (especially in the phase of the first Web enthusiasm), be it control by state or by business. But as Lawrence Lessig has pointed out clearly (Lessig 2006), there is simply no reason why this should be the case. This is neither good nor bad in itself; actually, it expresses only the fact that the Net is subject to (social, political, economical etc.) regulation, control, and power and that there is no choice that does not include some kind of building. "We can build, architect, or code cyberspace to protect values that we believe are fundamental. Or we can build, or architect, or code cyberspace to allow those values to disappear" (Lessig 2006, 6).

This is also the position of the Salzburg Approach. The concept of the Net as a technology for cooperation carries inside the aims and values of the GSIS notion. The accordant research programme related to this concept deals with ideas of how these aims could be developed as comprehensive design criteria for the Web, further enhancing the notion of a Web's architecture of participation. As mentioned above, this means building upon the heritage of the early wizards of the Net and Web, keeping their spirit of cooperation and participation but transferring and enhancing it dynamically according to the ever changing techno-social conditions and towards the aim of a GSIS.

4.2 Scope

If the scope of a science *about* the Information Society comprises the causes of current crises of global society and the respective remedies, the scope of an ICT-and-society transdiscipline is made up by the variety of conditions that influence the shaping of ICTs with the aim of supporting the advent of a GSIS having in mind. It follows from the definition of the task that the object of study has to be any condition that is crucial for the shaping of ICTs for a GSIS. These conditions cover facilitators of, as well as impediments to, the shaping of technologies for sustainable development.

4.2.1 Contradictions

Critical theory is materialistic in the sense that it addresses phenomena and problems not in terms of absolute ideas and predetermined societal development, but in terms of resource distribution and social struggles. Based on the insight that the basic resources are highly unequally divided in contemporary society, to construct a critical theory of ICT&S means to show how ICTs are related to questions concerning ownership, private property, resource distribution, social struggles, power, re-

source control, exploitation, and domination. In such an endavour a reactualised notion of class is of central importance (see Fuchs 2008, chapter 7.3).

Critical theory doesn't accept existing social structures as they are, it is not interested in society as it is, but in what it society could be and could become. It deconstructs ideologies that claim that something can't be changed and shows potential counter-tendencies and alternative modes of development. A critical theory of ICT&S is negative in so far as it relates the Internet to social problems and what society has failed to become and to tendencies that question and contradict the dominant and dominative mode of operation and hence have the potential to become positive forces of social changed towards the better. That the negative antagonisms are sublated into positive results is not an automatism, but depends on the realisation of practical forces of change that have a potential to rise from the inside of the systems in question in order to produce a transcendental outside that becomes a new whole.

In order to address the negativity of contemporary society and its potential, research also needs to be oriented on the totality. That dialectics is a science about totality in this context means that society is analysed on a macro-scale in order to grasp its problems and that reasons for the necessity of positive transformations are to be given. The need for a cooperative and participatory totality is theoretically grounded. For ICT&S Research this means to ground the necessity of a cooperative and participatory societal totality and the contribution that ICTs can make in this context.

4.2.2 Contradictions of Informatised Social Systems

Though the scope does not extend to any context of the genesis and usage of ICTs but is focused by the aims, it nevertheless cuts across a full range of different dimensions. The object of study is a complex one. It cannot be dealt with by a single discipline.

First, it cuts across all *societal spheres*. If we distinguish between sociosphere, ecosphere and technosphere, there are interrelationships inbetween them and relationships within them that are fostering or detrimental to societal development at any granularity – from the individual to the world society. The object of study consists in a variety of antagonisms (see Hofkirchner and Fuchs 2003 and Hofkirchner and Maier-Rabler 2004). Since informatisation is rather a catalyst of fundamental societal developments which are given a new appearance than a creator of possibilities *ab novo*, the antagonistic aggravation of tendencies in societal development on the threshold of the global information age is the continuation of lasting antagonisms. Regarding all societal spheres together, the beginning of the information age can be characterised by an antagonism between the information rich and the information poor in which the antagonism between inclusion and exclusion is continued in a different form.

In the cultural sphere the human process of self-expression of actors turned historically, under the premise of domination, into an antagonism between equality and

lacking in influence due to false consciousness. This antagonism turns again, in the course of informatisation, into an *antagonism between (scientific) rationality and (mass) mediatised manipulation*. The information revolution affects the mutual dependence of science, on the one hand, and values, ethics, morals, on the other, by giving more emphasis to the role scientific thoughts play within society. Science is committed to truth. Will the penetration of everyday life with science help suppress rules of social interaction that are not in compliance with findings that are claimed to be true and, in turn, will it help place an obligation on science to undertake inquiries for the sake of humane purposes only and will it thereby help create a true noosphere as Teilhard de Chardin (1975) and Vernadsky (see Hofkirchner 1997) were envisioning? Or will it contribute to distorting consciousness by disinfotainment and to distorting conscience, instead?

In the political sphere self-determination has become antagonistic when there has been domination. The antagonists are freedom and powerlessness which appear as *e-participation and Big Brother* to the inside and to the outside when entering the information age. The introduction of ICTs alters the nature of the polity: it becomes the agora of "noopolitik" where governmental and non-governmental actors meet, while bureaucracy turns into "cyberocracy" (Arquilla and Ronfeldt 1999, Ronfeldt 1992). What is at stake here is: Will the informatised polity empower the political actors? Or will it, instead, extend the control over them, be they interior or foreign (Information Warfare)?

In the economic sphere, there is self-preservation having been exposed to the clash of solidarity with expropriation in dominantly ordered societies and to the clash between the great hypertext which comprises all knowledge of humanity – "cosmopedia" (as Pierre Lévy coined it 1994, see 1997) –, that is, *knowledge as a commons and information monopolies* under the influence of ICTs. The information age is characterised by knowledge becoming an essential resource itself, becoming a new factor in the economic production process of society (Toffler 1980). "Knowledge mining", however, is confronted with a certain attribute of knowledge which has consequences for the proprietary handling of it. In sharp contrast to other goods, knowledge is a good that, in principle, is not used up after being used, it does not vanish. For that reason, knowledge turns into a seemingly infinite resource while economy is said to deal with scarcity. Thus the basic question of the informatisation of the sphere of economy runs: Will knowledge be made accessible for each economic actor who is in need of it? Or will knowledge be kept in the bounds of private ownership and treated as commodity, instead?

Summarising, as to the sociosphere, there is an underlying antagonism between the *human beings and the "Net"* (as pointed out by Castells 1996-1998). This antagonism of the information age goes back to the antagonism between justice and alienation from fellow human beings which is the form in which the production of sense appears in the epoch of domination. By the increasing number of ICT applications dislocated throughout the sociosphere the network society arises (Castells 1996). Networking means the increasing interdependence of the actors and the increasing dependence of the actors on access to the means of managing this interdependence which are provided by ICTs. Will networking facilitate the access to the supply and increase justice and, thus, raise social integrity? Or will it contribute to

social disparities and increase potential conflicts and raise the digital divide, instead?

As to the ecosphere, the human process of survival has been unfolding under domination into the contradictory tendencies of respect for and alienation from nature that again metamorphose, given the rise of the Information Society, into the contradiction between *human beings and "Gaia"* (Lovelock, 1987). Industrialisation multiplied material and energetic fluxes to an extent never seen before on earth. The flows threatened to get out of control. James R. Beniger (1986) calls the information revolution in this respect "control revolution" by which control over the flows can be regained. The question arises: Will the control revolution be used for restoring the balance between human living beings and their umwelt and raise ecological integrity? Or will it further the degradation of environment by means of computer usage, instead?

As to the technosphere, domination has been realising possible incongruities of human instrumental activities and making peace and security fight alienation from technology. ICTs intensify this conflict in the form of an opposition between *human beings and the "Megamachine"* (Mumford 1964). The spread of ICTs brings about a change in the very sphere of using and creating technology. Technology itself changes. By coupling with the computer which mechanises certain abilities of the human brain the machine of the industrial age which only mechanised abilities of the human body turns into an automaton. This holds for the whole realm of the infrastructure of society. The ambivalence of informatised technology comes to light: Will automation contribute to augment productive forces and further security and peace and by that raise civilisational integrity? Or will it serve destructive purposes and raise the vulnerability of the Information Society, instead?

Thus we see that, concerning the theory-reality-relation, the object of study is complex and includes aspects that cannot be dealt with by single disciplines like any of the social, environmental, technological sciences. The object of study is just the relationship between these different fields ususally dealt with by them (see Fig. 6).

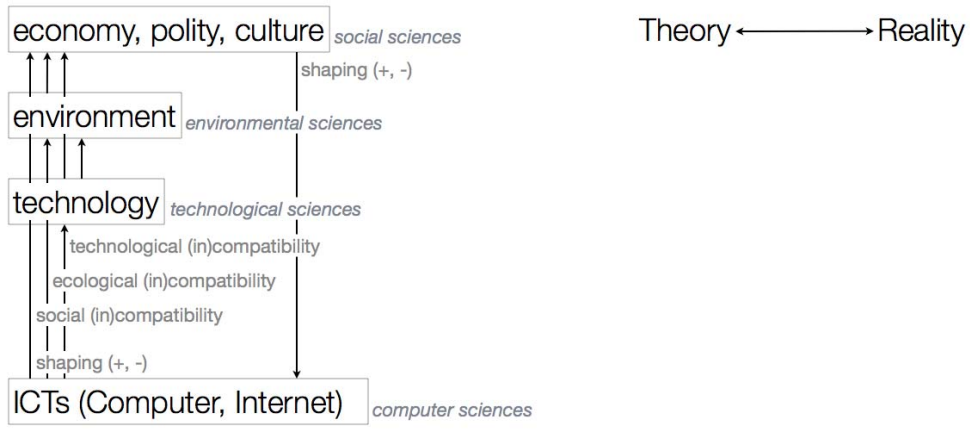

Figure 6: Societal subsystems the relationship between which is object of ICT&S Research

Second, besides cutting across societal subsystems, the object of study cuts across *different scales*. It is usual to distinguish between macro-, meso-, microlevels, the first being concerned with society at all, be it on the planetary scale or at the national scale, the second being concerned with organisations, specific institutions, social groups, the third with the inidvidual. The range of theories is accordingly different: it is grand social theories on the macrolevel, middle-range theories on the mesolevel, and micro-theories, including psychological ones, on the microlevel. ICT&S Research cannot be confined to one level. It needs to climb up and down the ladder, to switch between the levels and find out the relationship between them (see Fig. 7).

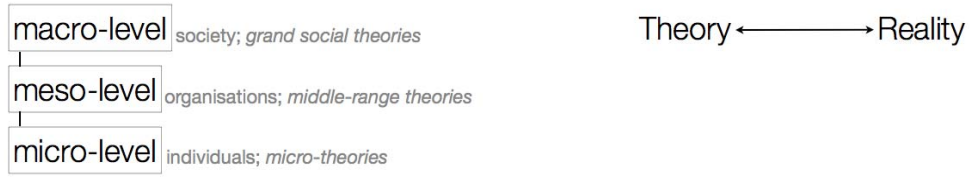

Figure 7: Levels the relationship between which is object of ICT&S Research

Third, besides cutting across societal subsystems at different levels, the object of study cuts across any *manifestation of information processes*.

For practical reasons, it makes sense to make use of the following distinction one of us introduced elsewhere (Hofkirchner 2002).

We come across information in three areas of society:

- in the area of cognition, that is, where the contents of consciousness is produced by individuals,

- in the area of communication, that is, where common understanding is produced by interactions (individuals),
- in the area of cooperation, that is, where sense embodied in societal structures is produced collectively by individuals who act in balanced ways.

The first and second areas go without saying, with cognitive science and communication studies as well-known fields of scientific activity. It is the third area that proves unconventional, as it contests a strong tradition in humanities that qualifies society as composed of communications only. Niklas Luhmann stands for this tradition. Introducing cooperation does, actually, justice to the "social facts" Emile Durkheim considered the proper object of sociology, to the "social relationships" Karl Marx distinguished from "social behaviour", to the "structure" that was focused on by the structuralist school after Marx, to the "synergy effects" that today can be investigated by science-of-complexity methods. That is, it does justice to the phenomenon that there is more to society than only communication on the level of interaction of individuals and that this whole – which is more than the sum of communications/interactions – is an information process too, albeit on the level of a social organisation.

Hence we can say, ICT&S Research – insofar as ICTs are technologies for mediating human information processes – comprises human cognition processes, human communication processes, and human cooperation processes. All three of them are, in a way, normative: cognition has the objective to position the individual vís-a-vís the societal, social, and nonhuman environment; communication aims at finding a state of mutual understanding between individuals on whatever matter it may be; and cooperation has a goal – that of a state of organisation of individuals that allows for a mutually beneficial common outcome. As a consequence, cognitive science, communication studies, and cultural studies, social science and the like insofar as dealing with the added value are sciences that inquire into human information processes. And ICT&S Research needs all of them, since it deals with the technological mediation of these societal functions which are interrelated in a specific way: in order to cooperate you need to communicate and in order to communicate you need to cognise.

ICTs as "tools for thought" as Howard Rheingold (1993, 2002) interprets the vision of the computer pioneer J.C.R. Licklider (see e.g. Licklider and Taylor 1968), serve the cognitive function. As a medium they serve the communicative function. And as "technologies for cooperation" they serve the cooperative function. For each perspective, there is a leading discipline: Human Computer Interaction (HCI) for the first one, Computer Mediated Communication (CMC) for the second one, and Computer Supported Cooperative Work (CSCW) for the third one. ICT&S Research has to build upon all of them, for in the search of the bigger picture it concentrates on the interrelations between them (see Fig. 8).

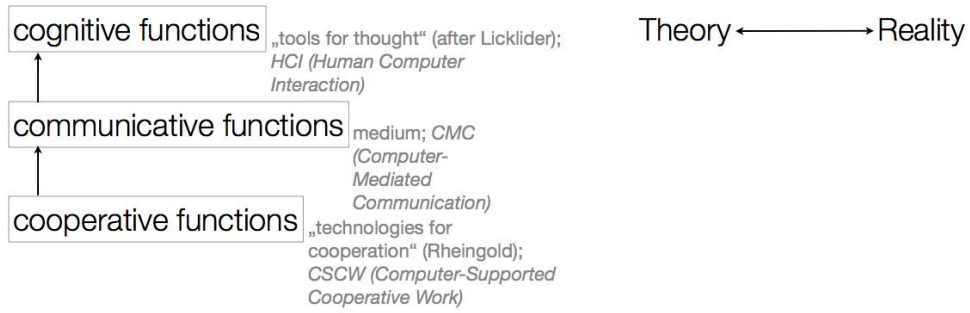

Figure 8: Information functions the relationship between which is object of ICT&S Research

Fourth, last not least, the object of study not only cuts across different societal subsystems at different levels and ICTs serving different information functions but also cuts across different *space and time coordinates*. As to space – where the synchronous dimension is addressed – we can distinguish the effects of ICTs and, vice versa, of society according to their range: there are short-range effects and long-range effects. Regarding time – where the diachronous dimension is in the foreground – we can distinguish short-term consequences from long-term consequences. Normally, synchronicity is the domain of sociology, while diachronicity is the domain of history and, say, futurology. ICT&S Research would be one-sided, if it would subscribe to only one of the spatio-temporal dimensions, because how things are structured synchronously depends on how they were generated diachronously (see Fig. 9).

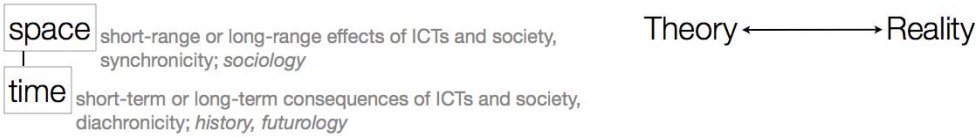

Figure 9: Space and time dimensions the relationship between which is object of ICT&S Research

4.2.3 Contradictions of the Net

Concerning the relationship of Internet and society (see Table 1) one can say that the Internet does have antagonistic social effects, it produces various tendencies that contradict each other and run counter to each other (Hofkirchner and Fuchs 2003, Fuchs and Hofkirchner 2003). This antagonistic character of Internet and society is the object of study. Antagonisms can be found in various subsystems of society: in the technosphere between alliance technology and the Megamachine, in the ecosphere between computer-supported sustainability and computer-supported degradation of the environment, in the economy between information as open-

source good and as monopolised commodity, in polity between e-democracy and Big Brother, and in culture between computer-supported wisdom and computer-supported manipulation (Hofkirchner and Fuchs 2003, Fuchs 2003). Contradictions of the Internet can be identified on different scales from the individual to the world society, in different information contexts from cognition through communication to cooperation, and on different time and space scales.

To take an example, there is the issue of open access. Knowledge that is produced by universities that pay the scientists for producing knowledge is, in the old paradigm, given away for free, that is, without gratification, to publishing houses to be published in peer-reviewed journals that, in turn, have to be bought back by the universities for their libraries. The Internet offers the technological potential of online journals that could rule out private publishing houses by open access. But publishing houses themselves discover the possibility of online journals and use it for better marketing. This is an antagonism in the interplay of different social subsystems like science, state, economy, to be found worldwide in the field of providing knowledge which serves a cognitive function as a current issue that may have mid- and long-term impacts. It is this very antagonism in its concrete manifestation that should form the object of a critical investigation.

In the case of Web 2.0 Social Software, e.g., grassroots, or citizen, journalism follows the same logic. On the one hand, there is the possibility of the "act of a citizen, or a group of citizens, playing an active role in the process of collecting, reporting, analyzing and disseminating news and information. The intent of this participation is to provide independent, reliable, accurate, wide-ranging and relevant information that a democracy requires" (Bowman and Willis 2003, 9). Now this citizen journalism is commercialised in that traditional print media and broadcasting networks utilise it to add-up professional journalism.

4.3 Tools

If the tools of a science *by means of* the Information Society, that is, the enhanced possibilities of knowledge technologies (to be) provided by Information Society, are expected to allow for unity of knowledge while keeping a diversity of disciplines, transdisciplinarity in ICT&S Research cannot mean an unconditioned "anything goes" but an "anything goes, if it works". As to the methods of ICT&S Research, there is no restriction of using and devising methods but the one: they must be appropriate for the study of the conditions that are crucial for the shaping of ICTs for a GSIS.

This means that the definition of the object of study as cutting across a multiplicity of societal spheres including ecology and technology, of scales, of technologically mediated human information process categories, of spatio-temporal dimensions, rules out disciplinary approaches and entails transdisciplinarity.

Furthermore, since the bringing about of a GSIS and the design of ICTs for this future is a complex task and since the challenges business, government, and civil society are facing in doing so are constituting a complex domain, the approach has

to be equally complex. In fact, it is the sciences of complexity that provide the adequate methods of investigation. This is to be understood in two ways:

- firstly, they give us hints on how to handle the problem of multiple methods on a metalevel, and,
- secondly, by the same token, they provide us with the proper means of study on an object level.

4.3.1 Unity through Diversity

Regarding the first point – the metalevel –, the French philosopher and sociologist Edgar Morin has stressed that the *conditio sine qua non* for success is a reform in thinking, not only in science: "The Planetary Era demands that we situate everything in the planetary context. Knowledge of the world as world has become an intellectual as well as a vital necessity. It is the universal problem of every citizen: how to gain access to global information, and how to acquire the possibility of linking together and organizing it. To do so, and thereby recognize, acknowledge, and know the problems of the world, we need a reform in thinking" (1999a, 124). After centuries of predominance of the analytical thinking, the paradigm change has to go in the direction of a synthetic overall view. However, this integrative view of what can be perceived by human intelligence does not need to, indeed must not, be a return to the pre-modern vision of the speculative natural philosophy of Antiquity. Rather, it can and must assimilate the knowledge gained from research in all disciplines in a historical process which rises from the abstract to the concrete.

It is the unity-through-diversity principle which is a principle of systemic thinking that provides us with the means to handle the problem that despite of, or because of, the usage of a variety of methods there is an urge for a unified methodology. Both variety and unity are achievable at the same time. Methodology yields as much cohesion as is needed to prevent the methods from falling apart and allows for as much a range of methods as is possible to investigate the subject matter from different perspectives.

This way of thinking was applied when Flood and Jackson (1991) dealing with the variety of approaches in the systems movement itself came up with their so-called System of Systems Methodologies which they called "complementarism" and, after slight modification in the tradition of their critical systems thinking, was, e.g., termed "discordant pluralism" (Gregory 1996). Complementarism or discordant pluralism does not mean that anything goes. "There is a need for debate about what are "good" arguments and what are not, and for discussion about how we can choose between different positions that are conflicting" (Gregory 1996, 54). Though "different perspectives and systems methodologies should be used in a complementary way to highlight and address different aspects of organizations, their issues and problems" (Jackson 2003, 285), they are brought together in a constellation that does not give way to a reduction to a common denominator but serves as the basis for a discourse that, as Gregory points out, is "not a relativistic chaos of unrelated factors, but a dialectical model" (Jay 1984, 15, cited in Gregory 1996, 54). The question of different perspectives is framed "in a way that recognizes the legitimacies of each position" involved. It "is a *third* perspective through which the le-

gitimacies of each value system can be brought together in a critically systemic discourse." This may include that "Such a constellation may *legitimately* eliminate elements of otherness that have been identified as illegitimate" (Gregory 1996, 55).

This is what we would like to extend to the realm of social-science and technology methods, beyond the border of system theory methods. On a metalevel, a methodology can be built that is a system of methods that, in turn, originate from different theoretical angles but undergo a process of critical reconsideration in order to suit a common methodological umbrella. The underlying way of thinking is a dialectical account of unity and diversity or identity and difference. Ways of thinking can be seen as ways of considering how to relate identity and difference (see Hofkirchner 2004). The dialectical one – which is opposed to reductionism, projectivism and dichotomism as well – establishes identity in line with the difference; it integrates both sides of the difference (yielding unity) and it differentiates identity (yielding diversity); it is a way of thinking that is based upon integration and differentiation; it is opposed to both unification and dissociation and yields unity and diversity in one – unity in diversity and diversity in unity. As Edgar Morin puts it: "It means understanding disjunctive, reductive thought by exercising thought that distinguishes and connects. It does not mean giving up knowledge of the parts for knowledge of the whole, or giving up analysis for synthesis, it means conjugating them. This is the challenge of complexity which ineluctably confronts us as our planetary era advances and evolves" (1999b, 19).

Thus, a system methodology is capable of doing justice to other methods and including them as well.

Methods and theory are closely connected. Methods is about how to approach the object of study, theory is about understanding the object of study. Understanding depends on the approach you take, however, the approach depends on the understanding. That is to say, if you approach an object in different ways, the resulting understanding will accordingly differ; and, on the other hand, a certain understanding precludes certain methods. So there is a dialectical relationship between scope and tools that has to be taken into account.

Regarding the theory–method relation, we propose a research programme for a framework of how – from a very particular level (the level of subfields of ICT&S Research) to a very universal level – theories of different range can be related so as to build an architecture of presuppositions that are methodologically meaningful (see Fig. 10). Research in ICTs and society – aiming at producing knowledge about Information Society and information technology – implies methodologically the application of a certain amount of knowledge about society and of a certain amount of knowledge about technology; to go on, knowledge about society implies knowledge about real-world entities society is just one instantiation of; finally, knowledge about such real-world entities implies knowledge about reality in general; and, to follow another strain of thought, knowledge about technology, in turn, implies knowledge about society and, in addition, implies knowledge about information processes; knowledge about information processes, in turn, implies knowledge about real-world entities and, in addition, knowledge about reality in general. The essential point to grasp here is that, willingly or not, being aware of this or not, findings on one level of abstraction are based upon assumptions on higher levels of abstraction; assump-

tions on a higher level of abstraction, willingly or not, being aware of this or not, work as guiding principles for the research on lower levels of abstraction. Therefore it is not only sensible but should be a must for scientific enterprises to make explicit what is implicit. Only if transparency is guaranteed, a scientific enterprise may deserve the qualification of a critical science.

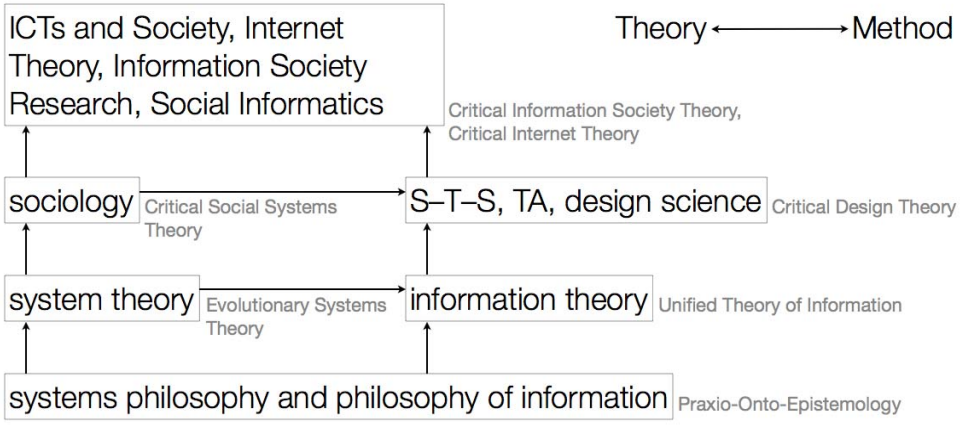

Figure 10: The eTheory methodological framework

However, in order to make this framework concise and consistent, we have to reframe these theories.

Critical theory is dialectical. It analyses phenomena, firstly, with the assumption that phenomena don't have linear causes and effects, but are contradictory, open, dynamic, and carry certain development potentials in them; secondly, based on the insight that there are neither only opportunities nor only risks inherent in social phenomena, but contradictory tendencies that pose both positive and negative potentials at the same time that are realised or suppressed by human social practice. A theory of ICT&S that is dialectical identifies antagonistic tendencies of the relationship of Internet and society and their opportunities and risks in order to help people and social groups to position themselves and find practical guidelines for action in the complexity of the contemporary world. Dialectic analysis in this context means complex dynamic thinking, In a dialectical analysis phenomena are analysed in terms of the dialectics of agency and structures, discontinuity and continuity, the one and the many, potentiality and actuality, global and local, virtual and real, optimism and pessimism, essence and existence, immanence and transcendence, etc.

4.3.2 An eTheory Framework

Regarding the second point of how complexity science can help us on the object level, we make use of the concept of complex systems. Thinking in complexity is

the best choice in matters of societal spheres including the technological sphere. Heinz von Foerster, founder of second-order cybernetics, mentioned in an interview that the term "science" means "to separate" [2]. Science generates knowledge by separating the essential from the non-essential. However there is systems thinking, cybernetics, and thinking in complexity. They form the countermovement to sciences that divide (Von Foerster 2003[3]). We propose to reconceptualise the respective spheres of society as complex systems (and the scales, information generativity, space and time as attributes of complex systems) by drawing distinctions that define the boundaries of the systems. "Boundaries are simultaneously a function of the activity of the system itself, and a product of the strategy of description involved. In other words, we frame the system by describing it in a certain way (for a certain purpose) but we are constrained in where the frame can be drawn. The boundary of the system is therefore neither a function of our description, nor is it a purely natural thing" (Cilliers 2001, 141). By doing so, we define the collection of elements systems are composed of, their environment, the relations among them, and the processes that specify one system compared to another one (Bunge 2003, 34 pp.).

Now – using the complex system concept – we can frame the theories in the foundational architecture as follows (see again Fig. Z):

- in the fields of ICTs and Society, Internet Theory, Information Society Research, Social Informatics, as a *Critical Information Society Theory*, part of which is a *Critical Internet Theory*;
- in the field of sociology, in particular, Grand Social Theory, as a *Critical Social Systems Theory*;
- in the fields of Science–Technology–Society, Technology Assessment, and Design Science, as a *Critical Design Theory*, including integrative TA and participatory design and social systems design;
- in the field of system theory as *Evolutionary Systems Theory*, based upon, and revisiting, General System Theory;
- in the fields of philosophy of systems and of information as *Praxio-Onto-Eistemology*.

Information Society is a social system is a self-organising system is an autonomous system, ICTs are a differentiated subsystem of Information Society mediating the information generation in Information Society.

Having said this, we are enabled to go beyond the chasm between the action-theoretical and structuralist accounts in sociology, if we conceive of each of the systems as entities that include agents: "individualism fails in social studies because it overlooks social structure; and holism fails even more spectacularly because it underrates individual action. Only systemism joins agency with structure, and urges the search for the mechanisms that make social systems and their constituents

[2] Etymologically, the prefix *sci* stands for "to separate". *Skei* [indogerm.] respectively *scio* [lat.] … *I know* means to understand, experience, (de-)part, separate, etc. See for example *scissors, schedule* or *schizophrenia (see* http://www.etymologie.info).

[3] This Interview was part of the documentary film "Das Netz" ("The Net") produced by Lutz Dammbeck in 2003. The film was broadcasted on February 16th 2006 on German Television ("Südwest Channel").

tick" (Bunge 2003, 75). The *dialectical relationship between agency and structure* being a process whose products freeze into structure, which in turn influences further processes of action as it enables them and constrains them at the same time, can easily be formulated in terms of a feed-forward and feed-back loop between society as a (supra-)system, and individuals or systems of individuals as elements or (sub-)systems: a loop that does not mediate strictly deterministic causations, but allows for the emergence of new qualities instead (Hofkirchner 1998, see Figure 11).

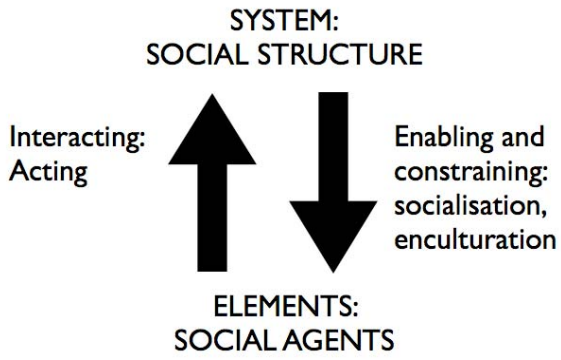

Figure 11: The dynamic of social self-organisation

This holds for technological systems too which we, consequently, can call techno-social systems. Being a *techno-social system* means that the core insight of theories of socio-technical systems from the Tavistock Institute to Günter Ropohl (1979, 2001) is applied to the object in question.[4] That is, technology is an inherently social phenomenon. Technology does not make sense unless embedded in the social context which animates it. Each technological infrastructure has to be kept at work by human support, has to be maintained, restorated, repaired, reproduced, adapted, modified, improved, and so on, which only human society is capable of doing. This means that every technology belongs to the technological infrastructure of a society, or the technosphere, that cannot in a senseful way be defined devoid of humans. The technosphere itself is a social system with individuals at the microlevel and technology at the macrolevel. The individuals are humans in their social role as "technicians" – as producers and as users of technology. Producing (devising and constructing) and using technology is the self-organisational dynamic of such a techno-social system (see Fig. 12).

[4] While appreciating every social science approach that acknowledges the social nature of technology, we find the notion of "socio-technological systems" misleading in that it seems to insinuate that there are technological systems which form a category and that there are socio-technological ones which form a subcategory of the former. It is rather the other way around. Technological systems are subsystems of social systems. Therefore we are inclined to coin the term "techno-social systems".

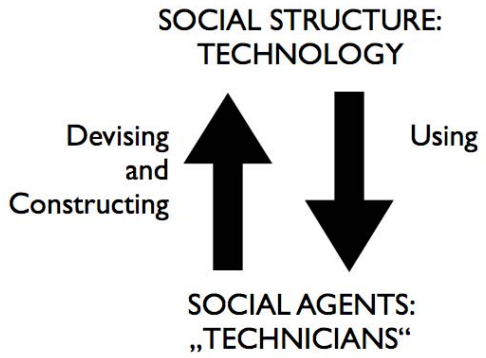

Figure 12: The dynamic of techno-social self-organisation

Upon closer scrutiny, there is another argument for the social nature of technology which goes beyond the argument concerning the inner dynamics of technology. Technology is inherently social also because it is so much embedded in the social context that it can be perceived as a subsystem of the overarching system of society. Technology is encapsulated in a nested hierarchy of systems.

The technosphere is considered to be just one instantiation of the overall self-organisation of society. Producing technologies for improving the productive force (innovating) and applying technologies (that augment production of whatsoever) for the improvement of the products to be consumed makes sense, that is, it is a kind of sense-production. Thus, in a specification hierarchy, the technosphere forms a *subsystem of the sociosphere*.

In a philosophical vein, it is a part-whole relationship that is characteristic of the technology-society relationship. The parts contribute to the emergence and maintenance of the whole, but the quality of the whole cannot be reduced to any quality of the parts. The whole exerts a pressure on the parts, but it will fail to wholly anticipate their interaction (Hofkirchner 2007).

By methodologically applying this part-whole relationship, we are enabled to conceive of the relation of ICTs and society in a way that avoids both the shortcomings of technological determinism and social constructivism. We label this position – in concert with other incidences in the literature (see e.g. Boczkowski 1999, 2004, and Nguyen 2007) – "*mutual-shaping*" approach (see Herdin, Hofkirchner and Maier-Rabler 2007). According to it, the relationship of technology (as a subsystem of society) and society as a whole is a complex, non-linear one. The form of a certain technology does not determine linear social consequences, but if society is indeed self-organising and complex one must assume that technologies can cause multiple, non-linear social effects that might even contradict each other. Technology influences society in non-linear ways, society influences technology in non-linear ways. The relationship of society and technology is shaped by complex, non-linear circular causality. Technology has the meaning, the purpose, the task of functioning as means and method for solving social problems. Social interests, cultural values,

norms and morals are thus in the origin and manifestation of technology, in its invention, diffusion and application, in the entire process of its development, as its reason for existence. This, however, is insufficient to enslave technology completely. Technology is ambivalent; sometimes it appears to resist our intentions by wholly or partly failing to do what is wanted of it, other times it not only fulfils our expectations but goes on to do other useful tasks which had not originally been anticipated. Technology represents a potential for the realisation of social goals. These technologically realisable goals may correspond to pre-existing goals within society; the practical attainment of these goals by technological means may, however, cause them to change, at least slightly. It is of course also possible that the intended goals may differ from those which can be reached with technological support. In this case, new technology may be developed in order to meet the requirements, or the requirements may, as it were, be adapted to fit the reality of what is technically possible. Realisable goals do not therefore always exist at the start of the process, but may be discovered as options made available by technology. Whether society decides to pursue these goals on the grounds that they are possible is no longer a question of technology, but rather of social decision-making (Hofkirchner 1994).

Besides recognising the inner dynamic of ICTs as well as their dynamical relationship with other social systems, we have to acknowledge something else that follows from the dynamic: an *evolutionary* perspective, that is, a perspective of a temporal sucession of phases. Self-organising systems show evolution. Techno-social systems evolve and ICTs are evolutionary systems to such an extent that the modern ICTs are even said to mark a turning point in the history of human civilisation.

The shift from one phase to a subsequent phase is tantamount to a shift onto a new layer. The new system includes this additional layer. It encapsulates what previously were autonomous systems as subsystems and shapes them to reflect the dominance relation. However, the newly formed system will always depend on the functioning of its subsystems. When they cease to support the system, it will break down. In terms of dialectical philosophy, the new sublates the old in the threefold Hegelian sense: it terminates the old, it conserves the old, and it raises the old onto another level. In terms of the stage model of evolution of systems, this means that the lower stages insofar as they build the basis of the new stage are reworked so as to fit the emerging quality of the new whole. In that case the notion of revolution is properly applied to societal evolution. Revolutions mark changes of quality of the societal system in the course of evolution. Revolutions change the basis of the societal system, they form a system that differs in quality from the system before.

There have been many arguments for looking upon history as a sequence of techno-social formations being brought about by certain revolutions and building one upon the former while restructuring the former: the Neolithic Revolution, which was a shift from nomadism to sedentariness with crop growing and cattle breeding, introduced the techno-social formation of agricultural society; the Industrial Revolution drew upon machine tool inventions of engineers and coupled them by transmission mechanisms with energy providing engines like the steam engine so as to result in work machines which gave rise to the techno-social formation of industrial society; and, with the words of Marshall McLuhan, “after we had extended

our bodies in space" in the ages of mechanical technology, by means of "electric technology", better: by means of the scientific-technological revolution in digitisation, we are on the point of extending "our central nervous system itself in a global embrace, abolishing both space and time as far as our planet is concerned" (1997, 3), enhancing the control of material production as well as supporting every information process in social systems, thereby ushering in the techno-social formation of informational society. Each new formation subjugated that from which it departed: the agricultural society increased the control of natural resources like plants and animals, the industrial society has been industrialising agriculture, and the informational society is informatising industry (see Fig. 13).

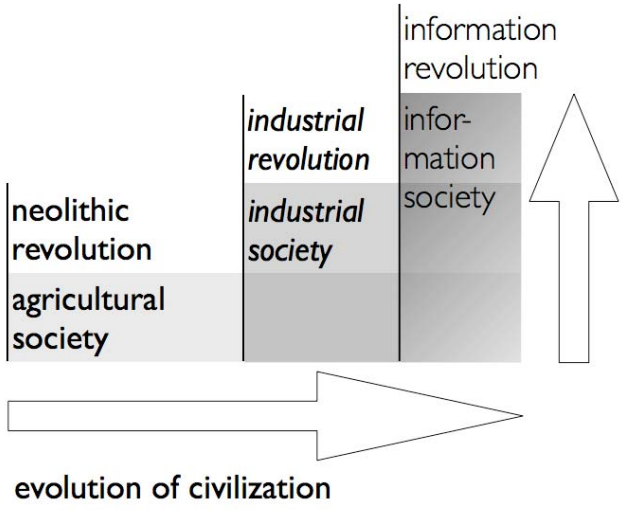

Figure 13: The dynamic of techno-social self-organisation over time

4.3.3 The Net as Complex System

What follows from the assumptions outlined above for the Internet and the Web (see Table 1) is that tools have to be used that regard the Net as

- a techno-social
- subsystem of society
- in evolution.

Firstly, the Net should be conceived as a techno-social system where human interaction and human activity results in the storage of knowledge. In this perspective, the Internet is not a system that links computers, but a techno-social system where a network of computer networks is used for linking and supporting the interactions of human beings.

Thus, the notion of the Internet as techno-social system refers to the fact that it cannot be defined without connection to the human social realm. On the one hand the Net is part of technological infrastructure of society, which is itself a

materialised outcome of social action. On the other hand it is a mediated social system of the three information processes cognition, communication and cooperation (CCC), which is based on the infrastructure as means of its realisation. In both cases the Internet is the result of the interactions of human agents as producers and users. They are the driving force behind the construction and reconstruction of this overall system in all of its facets. This logic of a techno-social production and reproduction refers to the dialectical relationship between human social agency and social structure as it is already described in the previous chapter as the central process of social self-organisation (see Fig. 14).

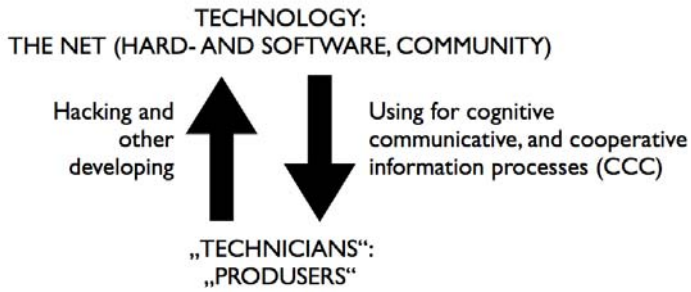

Figure 14: The dynamic of the Net's techno-social self-organisation

Secondly, the Net has te be considered basically embedded in the overall human social world, the sociosphere.

The Net as the world-spanning techno-social space of computer mediated CCC and as the central convergence-platform of all ICTs is clearly reflecting the current states and developments of the whole sociosphere.

But in turn, the Net as techno-social system itself generates new meaning and social structure as well, hence not only reflecting but also contributing to the evolutionary change of the overall socio-sphere of which it is a part of. In other words, the dynamic of the Net is intertwined with society at large in a mutual shaping way.

Figure 15 depicts the hierarchical embeddedness of the Net as techno-social system in the overall sociosphere in form of a mutual shaping process.

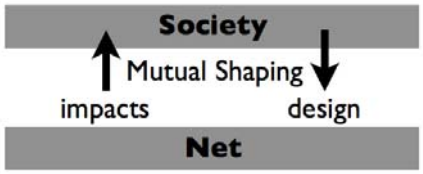

Figure 15: The Net as subsystem of society

Thirdly, we now can introduce the evolutionary stage model of the Net and inquire into the temporal succession of stages of, e.g., the World Wide Web. In our evolutionary model of the Web we distinguish three such stages: Web 1.0, Web 2.0, Web 3.0 (see Fig. 16 below). The stages can be seen as directly resembling the unfolding of sociality into ever higher forms of cooperation.

The x-axis is the timeline and shows different phases of the evolving Web (Web 1.0, 2.0, 3.0); the y-axis visualises the hierarchy of different levels, comprising the different forms of sociality (cognition, communication, cooperation). Each phase/level is the precondition for the next phase/level, but does not necessitate the next phase/level. If we shift from one phase to another, we also jump from one level to another. The new level subordinates the old level, reworks it, reontologises it, and forms together with it the system of the new phase.

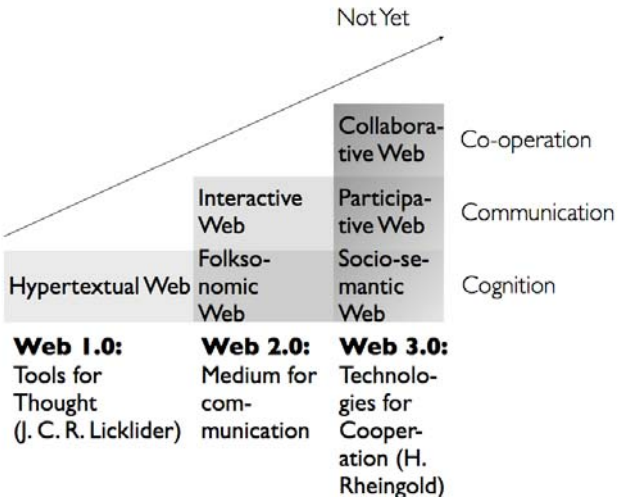

Figure 16: The dynamic of the techno-social self-organisation of the Web over time

The stage of *Web 1.0* is a web of cognition. It is mainly about the consumption of information (a cognitive process) that is presented in hypertext form. We name this state of Web evolution *hypertextual*.

The cognitive form of sociality represents the general basic layer in our model; it builds the fundament of all three stages. But as we will see, it changes in its quality when it reappears in the subsequent stages as it is reworked by the emerging higher new levels.

Since the beginning of the new millennium the character of the Web has successively been changing. With the rise of new heavily frequented platforms such as MySpace, YouTube, Facebook, Wikipedia, Friendster etc., communication and cooperation have become more important features of the Web. Our impression is that around 2005 Web 2.0 fully emerged and that the Web has entered a new phase of development. Web 3.0 is not-yet existent, but it shines forth in online cooperation systems such as Wikipedia.

In particular, we can name the new level that emerged in the transition to *Web 2.0 interactive*. Actually, the latter term can be explicated a bit clearer by connecting it to the notion of communities of interest which underly the whole Web 2.0 stage. These communities usually consist to a large extent of people who share a common interest or passion; they interact on the Web preliminary in terms of communication.

The general cognitive social level has turned into a *folksonomic* one. The term is derived from the word foksonomy, which is usually defined as social collective result of individual free tagging actions of all kinds of information and objects on the Web (Vander Wal 2007, online). We have chosen this word to express the difference to the hypertextual cognitive level of the first stage. Compared to the cognitive-social praxis of just browsing the Web, the term expresses a shift to a more intense form of sociality.

The second transition in our model might be characterised by the self-organised leap from the stage of Web 2.0 to that of *Web 3.0* in that the cooperation layer is added. Web 3.0 should be linked to the notion of community of action. Usually such communities consist of actors who do not only share a common interest or passion, but also develop associative social relationships and common goals for starting collective activity, thus achieving the possibility of bringing about real change.

Web 3.0 as a Not-Yet of societal development is anticipated by technologies like free software or wikis, but a fully cooperative Web needs to be embedded into a fully cooperative society, a GSIS in terms of the Salzburg Approach.

In analogy to the proposed understanding of the transformation of the first stage of the Web by the second one, we now suggest that *collaboration* in terms of communities of action might transform the interactive and folksonomic levels of Web 2.0 into a further deepened social exchange. We want to refer to such a social intensification on the communicative level as *participative*; hence the meaning of the interactive social is narrowed to some kind of real concern for each other in order to follow and achieve common goals. And on the cognitive level the folksonomic might be further developed into what is called now the *socio-semantic* Web. The term indicates a very interesting and just recent development in the field of Semantic Web research[5]; namely, the integration of social Web techniques (folksno-

[5]Very simplified, the basic idea of the Semantic Web can be conceived as an additional information layer in terms of knowledge representation which is imposed on the classical hypertext and document based web (W3C). These elements have the function of structuring the meaningful content of the web such that it can be automatically processed by machines. In its ideal consequences this would mean that computers or software do not any longer just parse web pages for displaying documents, hyperlinks and keywords but also for meaning based on structured collections of information and inference rules. Software agents could then roam from page to page, seek out knowledge distributed on the web, mesh it and take action based on it as instructed by the web user. However, multi-layered and deep controversies reaching from the development of the sophisticated technological standards to questions of the in principle feasibility and significance of such a project in terms of the socio-technical dimension of the Web have arisen.

mies, wikis) into the construction of so called "light weighted", community based Semantic Web solutions, thus immediately integrating the social aspect of community with the technical level of the Web to a new kind of intelligent symbiosis as the basic Web layer (van Damme, Hepp and Siorpaes 2007; Specia and Motta 2007; Siorpaes and Hepp 2007).

5 CONCLUSION

We tried to argue that the newly established field of ICT-and-society research must inhere transdisciplinary features, if it is to be critical of current socio-economic developments and aims for the establishment of a GSIS (global sustainable Information Society); if it is to tackle the complex problems of society and technology; if it is to use social-scientific and technological, empirical and theoretical methods in a proper way. We discussed the prospect of ICT-and-society research to become a transdiscipline and forerunners. We explained the concept of a transdiscipline. ICT&S Research as transdiscipline requires a unity of knowledge through a diversity of disciplines.

Traditional approaches to the field are shown as any industry-funded (resp. –funding) social-scientific rationalisation (aims) of any ICT application (scope) by any method whatsoever (tools). In contrast, integrative ICT assessment and design approaches develop a normative view of technology and society (aims), interprete their object of study as starting point for improving technology and society according to their normative criteria (scope), and use every method promising to shed light on causes and conditions that further or hinder the meeting of the normative criteria (tools). It is only the latter approaches that can be considered "critical".

REFERENCES

Alakeson, Vidhya/ Aldrich, Tim/ Goodman, James/ Jorgensen, Britt (2003). Making the Net Work. Sustainable Development in a Digital Society. Forum for the Future: Teddington.

Arnold, Matthew (1882). Literature and Science. In: http://www.chass.utoronto.ca/~ian/arnold.htm (25.07.2005).

Arquilla, John/ Ronfeldt, David (1999). The Emergence of Noopolitik. Toward an American Information Strategy. RAND: Santa Monica, etc.

Artigiani, Robert (1991). Social Evolution. A Nonequilibrium Systems Model. In: Laszlo, Ervin (Ed.). The New Evolutionary Paradigm. Gordon & Breach Science Publishers Ltd.: New York.

Bar-Hillel, Yehoshua/ Carnap, Rudolf (1953). Semantic Information. In: British Journal of the Philosophy of Science 4, pp. 147-157.

Bell, Daniel (1973). The Coming of Post-Industrial Society. Basic Books: New York.

Beniger, James R. (1986). The Control Revolution. Harvard University Press: Cambridge.

Berners-Lee, Tim/ Mark Fischetti (1999). Weaving the Web the Original Design and Ultimate Destiny of the World Wide Web by its Inventor. HarperSanFrancisco: SanFrancisco.

Bloch, Ernst (1967). Das Prinzip Hoffnung. 3 Vols. Suhrkamp: Frankfurt.

Boczkowski, Pablo (1999). Mutual shaping of users and technologies in a national virtual community. In: Journal of Communication, Volume 49, Number 2, 86–108.

Boczkowski, Pablo (2004). The Mutual Shaping of Technology and Society in Videotex Newspapers: Beyond the Diffusion and Social Shaping Perspectives. In: The Information Society, Volume 20, Number 4, 255-267.

Bowman, Shayne/ Willis, Chris (2003). We Media – How audiences are shaping the future of news and information. http://de.wikipedia.org/wiki/Graswurzel-Journalismus

Bradley, Gunilla (2006). Social and Community Informatics – Humans on the Net. Routledge: New York.

Bunge, Mario (2003). Emergence and Convergence: Qualitative Novelty and the Unity of Knowledge. University of Toronto Press: Toronto etc.

Bühl, Achim (1996). CyberSociety. Mythos und Realität der Informationsgesellschaft. PapyRossa Verlag: Köln.

Brockman, John (1995). The Third Culture. Beyond the Scientific Revolution, Simon & Schuster Verlag: New York.

Brzezinski, Zbigniew (1968). America in the Technetronic Age. In: Encounter, Volume 30, Number 1, 16-26.

Castells, Manuel (1996). The Rise of the Network Society. The Information Age: Economy, Society and Culture, Vol. I. Blackwell Publishers: Cambridge, MA/ Oxford.

Castells, Manuel (1997). The Power of Identity. The Information Age: Economy, Society and Culture, Vol. II. Blackwell Publishers: Cambridge, MA/ Oxford.

Castells, Manuel (1998). The End of Millenium. The Information Age: Economy, Society and Culture, Vol. III. Blackwell Publishers: Cambridge, MA/ Oxford.

Cilliers, Paul (2001). Boundaries, Hierarchies and Networks in Complex Systems. In: International Journal of Innovation Management, Volume 5, Number 2, 135–147.

Corning, Peter A. (1983). The Synergism Hypothesis. A Theory of Progressive Evolution. McGraw-Hill: New York.

De Vree, Johan K. (1990). Order and Disorder in the Human Universe. The Foundations of Behavioral and Social Science. 3 Vols. Prime Presss: Bilthoven.

Drucker, Peter F. (1969). The Age of Discontinuity. Harper & Row: New York.

Drucker, Peter (1993): Post-capitalist Society. Butterworth-Heinemann: Oxford.

Fleissner, Peter/ Hofkirchner, W. (1998). The Making Of The Information Society: Driving Forces, „Leitbilder" And The Imperative For Survival. In: BioSystems Volume 46, 201-207.

Flood, Robert L./ Jackson, Michael C. (1991). Creative Problem Solving: Total Systems Intervention. Wiley: New York.

Fuchs, Christian (2003). Globalization and Self-Organization in the Knowledge-Based Society. In: tripleC (http://triplec.uti.at/), Volume 1, Number 2, 105-169.

Fuchs, Christian (2005). The Internet as a Self-Organizing Socio-Technological System. In: Cybernetics and Human Knowing, Volume 12, Number 3, 37-81.

Fuchs, Christian (2006). Towards a Global Sustainable Information Society (GSIS)? In: tripleC (http://triplec.uti.at/), Volume 4, Number 1, 40-99.

Fuchs, Christian (2008). Internet and Society: Social Theory in the Information Age. New York: Routledge.

Fuchs, Christian/ Hofkirchner, Wolfgang (2003). Studienbuch Informatik und Gesellschaft. Libri BOD: Norderstedt.

Gibbons, Michael/ Nowotny, Helga (2002). The Potential of Transdisciplinarity. In: Bill, Alan/ Grossenbacher-Mansuy, Walter/ Häberli, Rudolf/ Scholz, Roland W./ Welti, Myrtha (Eds.). Transdisciplinarity: Joint Problem Solving among Science, Technology and Society. An Effective Way for Managing Complexity. Akademie Verlag: Berlin.

Goldammer, Eberhard von, Kaehr, Rudolf (1996). Transdisziplinarität in der Technologieforschung und Ausbildung. In: http://www.vordenker.de/transd/transd.htm, Institut für Kybernetik und Systemtheorie: Dortmund.

Gregory, Wendy (1996). Dealing with Diversity. In: Flood, Robert L., Romm, Norma R.A. (Eds.). Critical Systems Thinking, Current Research and Practice. Plenum Press: New York, London.

Häberli, Rudolf/ Thompson Klein, Julie (2002). Summary. In: Bill, Alan/ Grossenbacher-Mansuy, Walter/ Häberli, Rudolf/ Scholz, Roland W./ Welti, Myrtha (Eds.). Transdisciplinarity: Joint Problem Solving among Science, Technology and Society. An Effective Way for Managing Complexity. Akademie Verlag: Berlin.

Haefner, Klaus (1988). The Evolution of Information Processing (Paper)

Haefner, Klaus (1992a). Information Processing at the Sociotechnical Level. In: Haefner Klaus (1992b).

Haefner, Klaus (Ed.) (1992b). Evolution of Information Processing Systems. An Interdisciplinary Approach for a New Understanding of Nature and Society. Springer: Berlin, etc.

Harding, Sandra (1992) 'After the Neutrality Ideal: Science, Politics, and "Strong Objectivity"'. Social Research, Volume 59, Number 3, 567-587.

Hensel, Matthias (1990). Die Informationsgesellschaft. Neuere Ansätze zur Analyse eines Schlagwortes. Verlag Reinhard Fischer: München.

Herdin, Thomas/ Hofkirchner, Wolfgang/ Maier-Rabler, Ursula (2007). Culture and Technology: A Mutual-Shaping Approach. In: Ess, Charles/ Hongladarom, Soraj (Eds.). Information Technology Ethics: Cultural Perspectives. Idea Group Publishing: Hershey, PA.

Heylighen, Francis (1995). Selection of Organization at the Social Level. Obstacles and facilitators of metasystem transitions. In: Heylighen, Francis/ Joslyn, C/ Turchin, Valentin (Eds.). World Futures. Special Issue. The Quantum of Evolution: Toward a Theory of Metasystem Transitions. Journal of General Evolution Volume 45, 1-4.

Heylighen, Francis (1997). Towards a Gloabal Brain. Integrating Individuals into the World-Wide Electronic Network. In: Brandes, Uta/ Neumann, Claudia (Eds.): Der Sinn der Sinne. Steidl Verlag: Göttingen.

Hilty, Lorenz M./ Som Claudia/ Köhler Andreas (2004a). Assessing the Human, Social, and Environmental Risks of Pervasive Computing. In: Human and Ecological Risk Assessment, Volume 10, Number 5, 853-874.

Hilty, Lorenz M./ Som Claudia/ Köhler Andreas (2004b). The Precautionary Principle in the Information Society. In: Human and Ecological Risk Assessment, Volume 10, Number 5, 787-799.

Hilty, Lorenz M./ Behrendt, Siegfried/ Binswanger, Mathias/ Bruinink, Arend/ Erdmann, Lorenz/ Froehlich, Jürg/ Köhler, Andreas/ Kuster, Niels/ Som, Claudia/ Wuertenberger, Felix (2005). The Precautionary Principle in the Information Society. Effects of Pervasive Computing on Health and Environment. TA-SWISS, Center for Technology Assessment: Bern.

Hilty, Lorenz/ Ruddy, Thomas F. (2000). Towards a Sustainable Information Society. In: Informatik/Informatique, Volume 4, 2000, 2-7.

HLEG (1997). A European Information Society for Us All. In: htttp://www.ispo.cec.be/hleg/hleg.html.

Hofkirchner, Wolfgang (1994). On the Philosophy of Design and Assessment of Technology. In: Katsikides, Savvas A. (Ed.). Informatics, Organization and Society. Reihe OCG, Austrian ComputerSociety: Oldenbourg, Wien, München, 38–46.

Hofkirchner, Wolfgang (Ed.) (1997). Vladimir I. Vernadskij: Der Mensch in der Biosphäre, Zur Naturgeschichte der Vernunft. Peter Lang: Wien etc.

Hofkirchner, Wolfgang (1998). Emergence and the Logic of Explanation – An Argument for the Unity of Science. In: Acta Polytechnica Scandinavica, Mathematics, Computing and Management in Engineering Series, Volume 91, 23–30

Hofkirchner, Wolfgang (2002). Projekt Eine Welt: Kognition – Kommunikation – Kooperation. Versuch über die Selbstorganisation der Informationsgesellschaft. LIT-Verlag: Münster, Hamburg, London (Reihe Technikphilosophie, Band 9).

Hofkirchner, Wolfgang (2004). Unity Through Diversity. Dialectics – Systems Thinking – Semiotics. In: Trans, Volume 15.

Hofkirchner, Wolfgang (2007). A Critical Social Systems View of the Internet. In: Philosophy of the Social Sciences, Volume 37, Number 4, 471-500

Hofkirchner, Wolfgang/ Fuchs, Christian (2003). The Architecture of the Information Society. In: Wilby, Jennifer/ Allen, Janet K. (Eds). Proceedings of the 47th Annual Conference, ISSS (The International Society of the Systems Sciences), ISBN 0-9740735-1-2 (CD-ROM), 10.

Hofkirchner, Wolfgang/ Stockinger, Gottfried (2003). Towards a Unified Theory of Information. In: 404nOtF0und, Volume 1, Number 3.

Hofkirchner, Wolfgang/ Maier-Rabler, Ursula (2004). The Ethos of the Great Bifurcation. In: International Journal of Information Ethics (IJIE), Volume 2.

Hunsinger, Jeremy (2005). Toward a Transdisciplinary Internet Research, in: The Information Society, Volume 21, Number 4, 277-279.

Huxley, Thomas H. (1880). Science and Culture. In: http://www.fordham.edu/halsall/mod/1880huxley-scicult.html.

Ito, Youichi (1980). The "Johoka Shakai" Approach to the Study of Communication in Japan. In: KEIO Communication Review 1.

Ito, Youichi (1987). Mass Communication Research in Japan. History and Present State. In: McLaughlin, Margaret L. (Ed.): Communication Yearbook 10. Sage Publications: Newbury Park.

Jackson, Michael C. (2003). Systems Thinking: Creative Holism for Managers. John Wiley & Sons: Hoboken NJ.

Jay, Martin (1984). Adorno. Harvard University Press: Cambridge, MA.

Kim, Sung Tae/ Weaver, David (2002). Communication Research About the Internet: a Thematic Meta-analysis. In: New Media & Society, Number 4, 518 - 539.

Kleiber, Charles (2002). What Kind of Sciences Does our World Need Today and Tomorrow? A New Contract between Science and Society. In: Bill, Alan/ Grossenbacher-Mansuy, Walter/ Häberli, Rudolf/ Scholz, Roland W./ Welti, Myrtha (Eds.). Transdisciplinarity: Joint Problem Solving among Science, Technology and Society. An Effective Way for Managing Complexity. Akademie Verlag: Berlin.

Kreibich, Rolf (1986). Die Wissenschaftsgesellschaft. Von Galilei zur High-Tech-Revolution. Suhrkamp: Frankfurt/ Main.

Laszlo, Ervin (1998). Systemtheorie als Weltanschauung. Eine ganzheitliche Vision für unsere Zeit. Aus dem Englischen von Konrad Dietzfelbinger. Eugen Diederich Verlag: München.

Lepenies, Wolf (2002).. Die drei Kulturen. Soziologie zwischen Literatur und Wissenschaft. Fischer Taschenbuch Verlag: Frankfurt/ Main.

Lessig, Lawrence (2006). Code version 2.0. Basic Books.: New York..

Lévy, Pierre (1997). Collective Intelligence. Mankind's Emerging World in Cyberspace. Plenum Trade: New York.

Licklider, James C. R./ Taylor, R. (1968). The Computer as a Communication Device. In: Science and Technology, April.

Livingstone, Sonia (2005). 'Critical Debates in Internet Studies: Reflections on an Emerging Field', pp. 9-28 in J. Curran and M. Gurevitch (eds) Mass Media and Society. New York: Hodder Arnold.

Lovelock, John (1987). Gaia. Oxford University Press: Oxford.

Lyon, David (1988). The Information Society. Issues and Illusions. Polity Press: Cambridge.

Machlup, Fritz (1962). The Production and Distribution of Knowledge in the United States. Princeton University Press: Princeton.

Malaska, Pentti (1991). Economic and Social Evolution. The Transformational Dynamics Approach. In: Laszlo, Ervin (Ed.). The New Evolutionary Paradigm. Gordon & Breach Science Publishers Ltd.: New York.

Marx, Karl (1844). 'Einleitung zur Kritik der Hegelschen Rechtsphilosophie', pp. 378-391 in MEW, vol. 1. Berlin: Dietz.

McLuhan, Marshall (1967). Our dawning electric age. In: Mesthene, Emmanuel G. (Ed.). Technology and social change. Bobbs-Merrill: Indianapolis.

McLuhan, Marshall (1997). Understanding Media, The Extensions of Man. Routledge: London.

Miller, James Grier (1978). Living Systems. McGraw-Hill: New York.

Miller, James Grier/ Miller, Jessie L. (1992). Applications of Living Systems Theory. In: Levine, Ralph L./ Fitzgerald, Hiram E. (Eds). Analysis of Dynamic Psychological Systems. Plenum: New York.

Mittelstraß, Juergen (1992). Leonardo-Welt. Über Wissenschaft, Forschung und Verantwortung. Suhrkamp Taschenbuch Verlag: Frankfurt/ Main.

Mittelstraß, Juergen (2001). Wissen und Grenzen. Philosophische Studien. Suhrkamp Taschenbuch Verlag: Frankfurt/ Main.

Morin, Edgar, Kern, Anne Brigitte (1999a). Homeland Earth, A Manifesto for the New Millennium. Hampton Press: Cresskill, N.J.

Morin, Edgar (1999b). Seven Complex Lessons in Education for the Future, translated by Poller Nidra, http://portal.unesco.org/en/ev.php-URL_ID=2735&URL_DO=DO_TOPIC&URL_SECTION=201.html

Mumford, Lewis (1964). The Myth of the Machine. The Pentagon of Power. Harcourt, Brace, Jovanovich: New York.

Murdock, Graham and Peter Golding (2005). 'Culture, Communications and Political Economy', pp. 60-83 in J. Curran and M. Gurevitch (eds) Mass Media and Society. 4th Edition. New York: Hodder Arnold.

Münch, Richard (1991). Dialektik der Kommunikationsgesellschaft. Suhrkamp Taschenbuch Verlag: Frankfurt/ Main.

Münch, Richard (1995). Dynamik der Kommunikationsgesellschaft. Suhrkamp Taschenbuch Verlag: Frankfurt/ Main.

Nguyen, An (2007). The interaction between technologies and society: Lessons learnt from 160 evolutionary years of online news services. In:
First Monday, Volume 12, Number 3
http://firstmonday.org/issues/issue12_3/nguyen/ index.html

Nora, Simon/ Minc, Alain (1978). L' informatisation de la société. Documentation Française: Paris.

OECD/ICCP (1981). Information Activities, Electronics and Telecommunications Technologies. Impact on Employment, Growth and Trade. Paris.

OECD/ICCP (1985). Update of Information Sector Statistics. Paris.

Porat, Marc Uri (1976). The Information Economy. Stanford University Press: Stanford.

Raffl, Celina (2006). The Two Cultures: A Third Look. In: *Trappl*, Robert (Ed.). Cybernetics and Systems 2006. Austrian Society for Cybernetic Studies: Vienna.

Rheingold, Howard (1993). The Virtual Community: Homesteading on the Electronic Frontier. Perseus Books: New York.

Rheingold, Howard (2002). Smart Mobs. The next social revolution. Perseus Books: Cambridge, Masachusetts.

Ropohl, Günter (1979). Eine Systemtheorie der Technik. Hanser: München, Wien.

Ropohl, Günter (2001). Philosophy of Socio-Technical Systems. In: Lenk, H. (ed.), Advances and problems in the philosophy of technology. Lit-Verlag: Münster.

Servaes, Jan/ Carpentier, Nico (Eds.) (2006). Towards a Sustainable Information Society. Deconstructing WSIS. Intellect: Bristol.

Shannon, Claude E. (1948). A Mathematical Theory of Communication. In: Bell System Technical Journal, Volume 27, 398-403.

Snow, Charles Peirce (1998a, 1959). The Two Cultures. Cambridge University Press: Cambridge.

Snow, Charles Peirce (1998b, 1963). The Two Cultures: A Second Look, Cambridge University Press: Cambridge.

Spinner, Helmut F. (1994). Die Wissensordnung. Ein Leitkonzept für die dritte Grundordnung des Informationszeitalters. Leske + Budrich: Opladen.

Stehr, Nico (1994). Arbeit, Eigentum und Wissen. Zur Theorie von Wissensgesellschaften. Suhrkamp: Frankfurt/ Main.

Stock, Gregory (1993). Metaman. The Merging of Humans and Machines into a Global Superorganism. Simon and Schuster: New York.

Stokes, Donald E. (1997). Pasteur's Quadrant. Basic Science and Technological Innovation. Brookings Institution Press: Washington.

Stonier, Tom (1990). Information and the Internal Structure of the Universe. An Exploration into Information Physics. Springer: Berlin etc.

Stonier, Tom (1992). Beyond Information. The Natural History of Intelligence. Springer: Berlin etc.

Stonier, Tom (1997). Information and Meaning. An Evolutionary Perspective. Springer: Berlin etc.

Teilhard de Chardin, Pierre (1975). The Phenomenon of Man. Harper & Row: New York.

Toffler, Alvin (1980). The Third Wave. Pan Books: London.

Touraine, Alain (1969). La société post-industrielle. Denoël-Gonthier: Paris.

Vander Wal, Thomas (2007). Folksonomy Coinage and Definition. http://www.vanderwal.net/folksonomy.html.

Webster, Frank (1995). Theories of the Information Society. Routledge: London.

Weizsäcker, Carl F. von et al. (1973). Information und Imagination. Piper: München.

Weizsäcker, Carl F. von (1974). Die Einheit der Natur. dtv: München.

Weizsäcker, Carl F. von (1985). Aufbau der Physik. dtv: München.

Windelband, Wilhelm (1892). Geschichte und Naturwissenschaft. Rede zum Antritt des Rektorats der Kaiser-Wilhelms-Universität-Straßburg, gehalten am 1. Mai 1894. In: http://www.fh-augsburg.de/~harsch/germanica/Chronologie/19Jh/Windelband/win_rede.html.