# Unit I 8: Systems Theory

## 1. Summary

Systems arise from processes of differentiation. Systems consist of the interaction of elements, their relations to each other and the processes connected with them. Systems distinguish themselves from the system environment, i.e. from everything that is not part of the system. Furthermore, systems are characterized by equilibrium processes and self-organization.

## 2. Socio-cultural contexts as systems

Socio-cultural contexts can always be understood as social systems in the sense of systems theory. Systems theory can help to better recognize previously hidden aspects or connections in a socio-cultural context.

### 2.1 Difference as a Prerequisite for Systems

Earlier cultures started from the idea of a primordial substance from which everything originated or was created. In this primordial substance there was at first no differentiation, it was not differentiated or formed. There were no different things or parts. Only by separation or exclusion of certain parts or elements something new, a new whole, which differed from the remaining original substance, developed. To distinguish always means to delimit, to subdivide. Individual parts or components of the original substance were delimited. The difference arose. The system theory is based first of all on the difference, the distinction (cf. Krieger 1986:11).

But differentiation is only possible if - to remain with the image of the original substance - some elements or parts were put together in a special way. A compilation is called in Greek to systeme. In ancient usage "systema" had the meaning of "the composed", "the structure" (cf. Metzner 1993:31). A "system" is a somehow ordered whole, a put-together (Krieger 2004). Krieger (2004) remarks: "In the beginning, then, was distinction, difference. This is a principle of systems theory of discourse. This is why one speaks of difference theory (as in Luhmann, for example), because everything is grounded in a difference or a distinction. If there were no distinctions, then there would be nothing at all."

The question of where the differences come from is one that has been answered very differently over time. Some attributed the differences to a mythical creator god or a perhaps equally mythical "observer" (cf. Spencer Brown 1972). Others grounded the differences in the evolutionary process of the self-organizing universe (cf. Maturana/Varela 1987). Still others grasped the differences as historically and culturally given (cf. Schmidt 1994). Still others understood differences as elements of a "knowledge system" specialized in the production of differences (cf. Luhmann 1990b).

### 2.2 What is a system?

A system is based on three types of processes: On selection or choice processes, on the creation and maintenance of relationships or relations, and on control processes. To make a differentiation or distinction, we must

1. select or **segregate** (= choose) some elements from the totality of given elements,
2. order or **relate** these elements in a certain way.

Thus the two most important conditions for a system are fulfilled. But because a system is always dynamic, i.e. in motion, this is not enough. Therefore it needs

3. certain **operations or processes** to enable and maintain control of the system.

Let us summarize: A system always consists of a selection of elements and a demarcation against each other. The system elements have some form of relationship with each other. This relationship is maintained by control processes.

### 2.3 System and Environment

"If one has created a system by a distinction, then this system must be different from something else. That which is other than the system, that which is outside the system; that which contains everything that does not belong to the system, that is the environment. The system is first and foremost different from the environment. This is due to the fact that the system includes its own elements and thus excludes the environment. The distinction has an inclusive and exclusive effect. Environment is everything that is excluded from the system" (Krieger 1996:13). It follows that there can be no "environment" without "system". System and environment always belong together - because the system defines itself precisely by excluding everything that is not part of it.

Luhmann (1984:35) writes: "The starting point of every system-theoretical analysis has to be...the difference between system and environment. Systems are not merely occasional and not merely adaptive; they are structurally oriented to their environment and could not exist without environment. They constitute and they sustain themselves by generating and sustaining a difference from the environment, and they use their boundaries to regulate that difference. ... In this sense, boundary maintenance is system maintenance." And Luhmann (1984:36) continues: "The environment receives its unity only through the system and only relative to the system. It is in turn bounded by open horizons, but not by transgressible boundaries; it is therefore not itself a system. It is different for every system, since every system only excludes itself from its environment. Accordingly, there is no self-reflection and a fortiori no ability of the environment to act."

A central ability of any system is to reduce complexity and to order the relationships of the individual elements within the system boundaries. The system environment is highly complex, and - from the system's point of view - disordered and chaotic. Luhmann emphasizes that the environment is always more complex than the system (Luhmann 1984:249). However, this does not automatically mean that the system environment must actually be disordered and chaotic, it is so only in relation to the system - and to a greater extent than the system.

### 2.4 Self-organization of System

The system organizes itself and keeps itself in equilibrium by executing the system's own processes. Self-organization should not be understood as static. A system consists not only of elements that are in fixed connections, but also of operations or processes. Operations or processes are what the system does. Processes always run in a system-specific way.

A heating system that is switched on by a control loop - e.g., by a thermostat - whenever the room temperature falls below a certain minimum value, and switched off when a certain maximum value is reached, constitutes a system. This form of operation is called a feedback loop or control loop. As can be seen from this example of the heating system, the system equilibrium can take place in a fluid way, i.e. through several different sub-phases that oscillate between a maximum and a minimum value. Depending on how the corresponding minimum and maximum values are set from the outside, the individual heating and rest phases could be shorter or longer, occur at greater or smaller intervals.

Systems sooner or later find a state of equilibrium. The system has a value that does not trigger an operation, at which it does nothing. Therefore, "to an observer, it looks as if all the operations of the system are aimed at reaching this one state over and over again. This value is then called the setpoint or target value, because the system appears to act as if this value is to be maintained. Whenever other relevant values are registered, e.g. 'too hot' or 'too cold', the system operates until it registers its target value 'comfortable' again. Cybernetic systems are goal-directed in this sense ... The target value is like a purpose that guides (controls!) the operations of the system and thus appears as something the system strives for. And because system operations are undertaken only to bring the system back to the same point, i.e., to (maintain) stability and restore equilibrium, such systems are called homeostatic systems" (Krieger 1996:26).

Systems are not only homeostatic, i.e., in equilibrium, but they also organize themselves. Ebeling (1989:17) wrote: "By self-organization we mean an irreversible process that leads to more complex structures of the overall system through the cooperative action of subsystems. Self-organization is the elementary process of evolution, which is understood as an unlimited sequence of processes of self-organization. In this sense, the processes on Earth and in the cosmos are usually evolutionary processes that can be understood only in the context of their history, i.e., the entire chain of causative self-organization processes."

## 2.5 The Self-Organizing Universe as an Evolutionist Worldview

David Krieger (1996:33/34) also points out that systems theory also has a worldview dimension:

"Systems theory is also a worldview. Its claim to universality has a visionary character. This can be seen in the following considerations. System building means, as said, reduction of complexity. The most complex is the primal environment of absolute complexity, where all events are equally probable. This is the chaos before the world creation. The system forms against the chaos as problem solution. The first systems at the beginning of the world were purely physical. The principle of their organization was the laws of nature that structured physical, chemical systems. To cope with environmental complexity, the system must form self-complexity through structural differentiation. The more intrinsic complexity a system has, the more environmental complexity it can successfully reduce. As in the air conditioner model, the system could successfully respond to different environmental events thanks to its internal differentiation into cooling system and heating system. So the evolution runs in the direction of self-organization and emergence of more and more complex systems.

Now, when the first physical systems themselves became too complex, as for example by the formation of immensely large molecules in the primordial ocean, their complexity had to be further reduced. This happened by the emergence of a higher principle of order, i.e. by an evolutionary jump to a higher form of systems. These were the systems organized on the basis of a genetic code, i.e. living systems. Here again the problem of complexity can be solved only by reduction. This means that the absolute complexity of the environment drives the evolution to more and more complex living systems.

Now, when the living systems themselves became too complex, e.g. by the development of a central nervous system and a cerebrum, then again an evolutionary leap to a higher level of emergent [=emerging, arising, note CJ] order happened. These were the systems organized on the basis of a semiotic code, i.e. psycho-social systems of meaning. Again, the tendency of evolution is that these systems themselves become more and more complex through internal differentiation, as the history of civilization shows.

That now the problem of complexity is solved by a fourth evolutionary leap to an even higher emergent order can be assumed from theory. But since we are 'trapped' in our semiotic order, we cannot think of any other ordering principle. Such a possibility is not within the horizon of our perception. So we cannot imagine what the next evolutionary leap will look like. It appears for us as an open horizon of possibility, as the transcendent par excellence, as the unmastered contingency of our human existence.

On the basis of the theory it can be said in general that the evolution runs in the direction of ever higher system complexity and ever higher contingency or variability and transformability. It seems to be the goal of the evolution to take up the complexity of the environment into the total system of universal order and to repeat it in it. What was outside is reproduced inside. As Jantsch (1987:181) says, 'It is not in the construction of hierarchy, but in the unfolding of complexity that the real work of evolution lies.' Complexity, then, is not only at the beginning of the world, but is apparently also the goal of its evolution. Systems become more and more complex to cope with the absolute complexity of the environment. Complexity is always brought forward in evolution and thus maintained as a problem" (Krieger 1996:33/34).

As can be seen, systems theory can certainly be thought in evolutionist terms. This is not a problem as long as it does not make judgmental statements, as has happened in the evolutionist theory of culture. If, however, evolution is thought in terms of an increasing complexity of social systems, the direction of development remains open in terms of content.

However, there is an objection to this theory: social or socio-cultural systems do not have to develop only in the direction of increasing complexity; the reverse can also be the case. In situations of anomie - i.e. when normative social institutions break down or in disintegrative periods - systems may well evolve towards lower complexity - or be replaced by systems with a lower degree of complexity.

Furthermore, the complexity of a social system may have become so great that the system can no longer survive in the long term, for example if the processes have become too complex and diverse. It is known from management research, for example, that above a certain size and complexity, it is essential for companies to reduce the size and complexity of their processes again - otherwise they run the risk of becoming loss-making, which means that they are no longer able to survive.

## 2.6 Biological Systems

David Krieger (1996:36) points out that "a system that produces itself, ... according to Maturana (1985), autopoietic. [is called]. 'Auto-poiesis' means 'self-generating', from the Greek 'auto' = 'self' and 'poiein' = 'to make', 'to bring forth'. Systems consist of elements in certain relations, which enable certain operations. Now if the operations of a system consist in producing the elements and relations of which it itself consists - and in doing nothing else - then this system is an autopoietic system. That is, it is a system whose goal is nothing but itself."

Maturana (1985) defined "autopoietic" as follows: "The autopoietic organization is defined as an entity by a network of production of constituents that (1) recursively participate in the same network of production of constituents that produces those constituents, and (2) realize the network of production as an entity in the space where the constituents are located. Consider, for example, the case of a cell: a cell is a network of chemical reactions that molecules produce in such a way that they 1. produce, or recursively participate in, through their interactions, the very network of reactions that they themselves produced, and that 2. realize the cell as a material entity. The cell, therefore, remains as a natural entity, separable topographically and operationally from its environment, only as long as this organization of its is consistently realized through perpetual turnover of matter, regardless of the changes in its form or the specificity of the chemical reactions constituting it" (Maturana 1985:158).

In Luhmann's (1995:56) sense, systems are autopoietic, "producing and reproducing themselves through the elements of which they are composed." Here, the relations to the system environment are on a different level of reality than the autopoietic system itself (cf. Luhmann 1995:56, cf. also Akalin 2011:185).

David Krieger (1996:36/37) concludes that "A system whose product is something other than the system itself, such as the air conditioner, which produces heat or cold and thus aims at a certain state in the environment, is not autopoietic, but allopoietic. The goal is not the production of its own elements and organization. Nevertheless, there are similarities. Self-generating systems operate like allopoietic systems in that they "try" to maintain their set point. Thus, they are homeostatic and cybernetic, but unlike allopoietic machines, living systems are oriented to their own organization, i.e., their set point is not imposed on them from the outside, but is set by their own organization. They do not "operate", they "act". They do not act to cause something in the environment, but to be able to continue to act, to maintain themselves in their organization, or in other words, to maintain their autopoiesis. So whatever it is about events in the environment that autopoietic systems respond to, they respond not to change or restore some state in the environment determined by a physical code, but solely to be able to continue their autopoiesis. The air conditioning system begins to operate when information is registered: Heat or Cold. The operations cause the air temperature to become different. The living being responds to the same inputs not according to a mechanistic code, but according to a genetic code that only regulates the autopoiesis of the system. So the living being can react differently. For example, it may react to cold or heat in such a way that it runs away instead of trying to change the environment. Because it is not concerned with the environment, but with itself. A system that is concerned with itself is autonomous. Autonomy means that the system, by virtue of its own structure, determines the series of state sequences through which it passes. Thus, the changes of state of the system are not controlled "from the outside",? but controlled by the internal genetic code".

According to Krieger (1996:39), "structural plasticity, or the ability of an autopoietic system to change its structure even though it is structurally determined, ... is referred to as adaptation. The term 'adaptation' is misleading in that it presents the image of a more or less conscious correspondence between system and environment. However, an operationally and informationally closed system cannot 'recognize' the environment per se, but can only react to impulses, disturbances, perturbations due to its own structure. Now, if the system has the ability to change its structure, and if indeed the structure of the system changes through interactions with the environment in such a way that the system can continue its autopoiesis, then this looks to an observer as if the system has 'adapted' to its environment. Instead of adaptation, systems theory prefers to speak of a structural coupling between organism and environment."

Maturana/Varela (1987:101/102) describe this structural coupling thus, "Since a structurally specified system can undergo only state changes specified by its structure, the range of structural plasticity of a composite entity is determined by its structure and not by the medium in which the entity operates and is realized as an entity. The medium can only perturb a structurally plastic system and cause a change of state that it does not specify. Under these circumstances, the perturbations by the medium act as selectors of the structural transformations of the perturbed entity; and the sequence of perturbations that the medium triggers in the history of the interactions of a given entity acts as a selector of the sequence or course of structural changes that the entity follows in that history. This results in the establishment of a structural correspondence between the given entity and the medium in which it operates, which appears to an observer as an adaptation or structural coupling."

## 2.7 Actor-Network Theory (ANT).

Actor-network theory, which has been increasingly discussed in recent years, especially in media studies and in historical studies, can be understood as a continuation of systems theory. Elements of these systems - or just: Networks - are human and non-human actors. "ANT can be understood ... as a cartographic procedure that traces the (changeable) topography of the social. This topography is shaped by groups of hybrid entities, with human and non-human parts. The relations between the entities of the network have to be maintained in each case in an elaborate way. The non-human entities play an important role in this process, because it is they who are primarily able to stabilize interhuman relations" (Rudin 2011:281). Non-human entities can be, for example, files in psychiatry or in the penal system, buildings or rooms. In the sense of ANT, actors are two things: on the one hand "sets of relations" and on the other hand "nodes into sets of relations" (cf. Röhle 2011:186). It follows that in actor-network theory two lines of sight are taken: "Actors are to be perceived as acting entities on the one hand, but on the other hand they are always relationally constituted themselves" (Röhle 2011:186). According to Latour (1994:33), actors are hybrids, that is, composed of human actor and non-human instruments, artifacts, or social institutions. Latour (1994:33) gives, for example, the example of a human who becomes a "gunman", i.e. a shooter, through a firearm. Human actors and non-human actants interact and act together. Thereby - according to Latour (1994:34 and 54) - there is a kind of symmetry between (human) actor and (non-human) actant, and both together share the responsibility for acting. Latour calls this interplay "mediation" (Latour 1994:34). In the process, the techniques change our expression, our action - and not only formally, they also change the action itself. According to Latour (1994:45), abilities and possibilities for action do not (any longer) lie exclusively with people, but also with techniques. Therefore, a new paradigm for a sociological theory of the social is needed today - the Actor-Network-Theory ANT. This theory sees humans and non-human actors acting in a collective (cf. Latour 1994:49), they act together as a network.

In this context, the behavior of a network is shaped by the paths (structures) and by the exchange of interactions (dynamics) (cf. Belliger/Krieger 2014:62). The network thereby creates a unified space for human and non-human actors (cf. Robert/Dufresne 2015:1).

In contrast to classical social science approaches, which explain social phenomena or actions with social aggregates (cf. Latour 2005:8) or regularities behind them, nothing exists behind these actions that generates them, so to speak (cf. Moore/Singh 2015:78).

In cultural anthropology, actor-network theory also lends itself as a method to redefine the reciprocal relationship between technology and society. According to Belliger/Krieger (2006:16), actor-network theory "shakes up the traditional separation of society and technology"; indeed, Belliger/Krieger (2006:39) speak of both human and non-human actors as "constructions" and as "hybrids" "consisting of more or less diverse elements." Actor-network theory postulates to consider humans as well as technical apparatuses as social actors, which - according to Belliger/Krieger's (2006:15) assessment - is "more radical [than] any constructivism". Every distinction between acting human subject and technical object is abolished - a radical system concept emerges.

Against the radical system concept, Kolster (2016:36) has objected, not without reason, from the perspective of neurobiology: "Against the assertion that all reality is only a subjective construct, it has been shown ... that the construction is subject to the conditions of the brain, the sense organs, the body, and the environmental stimuli. The theories that explain perception from a process of its coming into being, such as those of radical constructivism, have had to acknowledge these conditions. The specification of the sensory systems, the differentiation of the neuronal processes and the topography of the brain allow to conclude a differentiation of the environmental stimuli. Even if no depictable external world is demonstrable, a differentiation of environmental stimuli and their influence on the subjective perceptual construct will not be denied by the radical constructivists." Seen in this light, actor-network theory is not more radical but less radical than radical constructivism because networks are not understood simply as constructs of human consciousness but, as it were, as an extended interactional periphery and, at the same time, as a transhuman wholeness of human and nonhuman actors.

According to Rees (2011:95), ANT today represents a research stance rather than a theory. ANT today is often understood as a particular "approach, namely that of slow contemplation and engagement with its objects of study" (Rees 2011:95). Or as Belliger/Krieger (2014:15) paraphrase: Actor-Network-Theory represents a new rationality: "Rationality ... can be found within the context of those communicative practices that effectively build and maintain networks. In opposition to postmodernism and poststructuralism we will claim that rationality does not lie in dismantling grand narratives and laying bare differences, but in making associations, linking things together, building collectives, in short, networking".

What is special about actor-network theory is that "non-human actors" such as the material infrastructure of research, e.g., measurement devices, cameras, laboratory equipment, etc., are understood as an integral part of a research network - they make an important contribution to the research process just as human actors do. In this context, things are not to be treated like people, but human and other entities are confronted with the question:

"What contribution do these actors make to making something happen the way it does in a network of other actors?" (Passoth 2011:266). This transgresses and de-subjectifies systems theory, so to speak: Relations now refer not only to actors acting more or less consciously, but to all people and objects that are involved in the process in a way that is relevant to the outcome. This results in something like a new rationality: from the network, i.e., from the interaction of human and non-human actors, a separate, new rationality of the network emerges (cf. Belliger/Krieger 2014:16). According to Belliger and Krieger (2014:18), no one can escape the rationality of the network, and in the broader sense of the global network: "Attempts not to participate in networking and not to follow network norms increasingly appear irrational and resemble a psychosocial pathology" (Belliger/Krieger 2014:18), i.e., pathological behavior. But with this - one would have to object - this understanding of "global network" exposes itself as appropriating and ultimately totalitarian.

A particular problem in networks is the question of exercised power. Following Castells, Belliger/Krieger (2016:3) point out that in networks "power" is exercised in two forms: On the one hand, by a "network elite" that has the knowledge and the ability to program networks, and on the other hand, by so-called "switchers", i.e. all those who can switch back and forth between networks. It must be said, however, that the first group ("programming elite") has extensive definitional power, while the second group has only "user power," i.e., the power to use. They can either use an offered network or ignore it - nothing more. A qualitative or structural co-design of the network is - if at all - possible to an extremely limited extent (cf. also Jäggi in VPOD Bildungspolitik of March 2017:41/42).

In principle, this creates a kind of "two-class society", similar to the status of the (ordained) priests and the laity in the Catholic Church. This raises the question of whether, and if so how, "egalitarian" networks are conceivable from the perspective of network theory. Here, the norms attributed to networks by Belliger and Krieger (2016:4), such as connectivity, flow, transparency, and authenticity, remain either purely technical (connectivity and flow) or purely appellative (transparency and authenticity).

## 2.8 Wars as Conflictual Systems

Wars can be understood in different ways in terms of systems theory.

First, wars can be viewed as **transitional situations in a system** - for example, in a network of nation-states or, in the case of a civil war, in a single state. In particular, shorter warlike periods often express a change in an existing system. In this case, the warlike period or violent confrontation creates a new equilibrium in the system in question by changing the relationship between individual actors in the system and increasing or decreasing the weight of individual actors. It may also be that additional actors appear in the system, creating a new equilibrium.

**Case study Bosnian war**
In the Bosnian war in the 1990s, brutal armed conflicts between Bosnian Serbs, Muslims and Croats occurred during 3 ½ years. With the influence of the Americans and the EU Europeans - who finally pushed through the end of the war in the form of the Dayton Agreement on December 14, 1995 - a new equilibrium was created, which - among other things with the help of troops - still exists today.

Long-lasting wars can - secondly - establish their **own conflictual system** for a certain period of time, which can exhibit a certain equilibrium. This is especially true when there is little dynamism on the battlefield, or when the warlike actions are only one level of interaction among many - as, for example, during the Thirty Years' War, which produced its own system of successive interventions. According to Matuszek (2007:49), in many wars "self-sustaining mechanisms develop that provide for the reproduction of the conflict. The friend/foe code not only constitutes the unity and cohesiveness of the war system, but at the same time guarantees its autopoiesis." In the process, mechanisms emerge that keep the war system going and continuously reproduce it.

Second, by "own conflictual system" is meant that a conflict can, as it were, take on a life of its own, consisting of the two parties to the conflict, whereby - even without much dynamism in the theater of war - both parties condition each other and thus maintain the conflict. Examples of such situations would include the "drôle de guerre" in France after its declaration of war on Germany and before the German invasion in World War II. This situation was characterized by mutual "sitting still" of the conflict armies (Maginot Line). Much dynamism means many acts of war (e.g., in the second half of 2016 on the war front in Aleppo) shifting front lines (such as the recapture of Palmyra in December 2016 by IS). However, little dynamism (= movements in the course of the war) does not mean that the conflict no longer exists - often everything is seen under the aspect of conflict in this context (as, for example, in Bosnia until very recently), without the need for armed action. A theater of war with "low momentum" can suddenly turn into high momentum again, for example when an external or internal factor changes (e.g., external aid, new conflict hotspots, arms deliveries). For example, the Syrian conflict was characterized by low dynamics for a long time (stalemate between rebels and government), increased Russian intervention in 2016 increased the number of acts of war, Aleppo was attacked and bombed more, etc.).

**World War I case study**
An example of such a conflict system, which lasted 4 years after all, was the First World War. The war of position, especially between Germany and France, proceeded for months as a more or less stable front at the same place – and at times without major war actions. Both sides tried to change the situation in their favor through rearmament, material and tactics, but largely without success. It was not until the United States entered World War I that this conflictual equilibrium broke down and very soon Germany had to capitulate.

Like other systems, warlike systems can be recognized by the fact that - over a longer period of time - a kind of equilibrium settles in, with violent actions being the dominant form of interaction between the system actors. The action of one actor - e.g., a military offensive - is followed by a counteraction - e.g., a defensive measure - by the other side. However, even in a conflictual system, all actions are never overtly violent. Levels of action such as disinformation, propaganda, intelligence and espionage actions, etc. are also components of such a conflictual system.

Third, a war can also be understood as a redefinition of the system-environment boundary. This is especially true of wars of expansion, such as the warlike expulsion of Native American Indians during the settlement of the North American continent by Europeans. By advancing ever westward and incorporating the habitat of many Native American tribes, the settlers continually expanded the boundaries of their political system by incorporating substantial areas of the system environment into the system. The Indians were defined as a system environment and systematically displaced-they had no place in the new system.

It is a definitional question how long a war must be understood as a transitional change within the framework of an existing system and when the war itself must be understood as a conflictual system.

## 2.9 Ethical Aspects

In principle, systems theory does not offer criteria for the ethical evaluation of a system. Rather, it describes the size, complexity, equilibrium and self-organization of any system. Systems can be conflictual or low-conflict, organized in an egalitarian manner or characterized by very unequal attribution of power to individual actors. Systems can be destructive to their environment, or preservative and sustainable. In social or socio-cultural systems, people can be treated fairly or unfairly, be happy or unhappy. Therefore, systems theory is very suitable for describing procedures, structures and processes, but it is completely unsuitable for generating ethical statements.

# 3. Control Questions

1. How is difference important in systems theory?
2. What three properties or aspects are found in any system?
3. Explain the meaning of the system boundary.
4. Why is the system environment more complex and chaotic than the system from the system's point of view?
5. What is the importance of self-organization in a system?
6. Explain how an evolutionary systems theory has a worldview dimension.
7. Explain the basic theses of actor-network theory.
8. Explain the three possible systems theory variants of war.
9. Does systems theory offer ethical criteria for judgment?

## 4. Links

**Systemtheorie**
**Systemisches Denken heute**
http://www.systemische-beratung.de/systemtheorie.htm

**Text zur Systemtheorie**
http://www.thur.de/philo/assyst.htm

**Ragnar Heil - System thinking**
http://www.systems-thinking.de/

**Radical Constructivism**
http://www.univie.ac.at/constructivism/index.html

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