Systems Theory

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Systems theory is a science which has the comparative study of systems as its object. There are different types of systems: organisms (animals, humans, particularly cognitive mechanisms in organisms), machines (particularly computers), physicochemical systems, psychic systems and social systems. Such a comparative research program for heterogeneous types of systems presupposes a highly general concept of systems, for which numerous features have been proposed: the interdependency of the parts of a system; the reference of any structure and process in a system to the environments of the system; equilibrium and adaptedness and continuous re-adaptations to environmental demands as core elements of the understanding of a system; self-organization of a system as the principal way it responds to external intervention; complexity as trigger mechanism for system-formation and as the form which describes the internal network structures of connectedness among system elements.

General System Theory, Information Theory, Cybernetics

Systems theory in an understanding related to these definitions developed in the years after 1940 on the basis of suggestions from biology (the 'General System Theory' of Ludwig von Bertalanffy), physiology (Walter B. Cannon, Walter Pitts, Warren McCulloch), and information theory and cybernetics (Claude Shannon, Norbert Wiener, William Ross Ashby). Particularly the idea by Shannon and Wiener to define information as a selection among alternative possibilities turned out to be a generalization transcending heterogeneous systems and pointing to systems theory as a kind of general selection theory. This was connected to the strictly binary way of operation Pitts and McCulloch postulated in a paper from 1943 for

the nerve cell. This idea that at any branching of nerve cells there are only two alternative states available proved to be the most simple suggestion of how to make use of a network of cells for long chains of numerical operations. From this came the computer and at the same time more general ideas regarding the operational realities of any observing system whichsoever.

Since its beginnings the social sciences were an important part of the establishment of systems theory. Jürgen Ruesch and Gregory Bateson were in 1951 the first who tried to base a social science discipline on an information and communication theory coming from cybernetics ("Communication. The Social Matrix of Psychiatry"). But the two most influential suggestions were the comprehensive sociological versions of systems theory which were proposed by Talcott Parsons since the 1950s and by Niklas Luhmann since the 1970s.

Talcott Parsons (1902-1979)

Talcott Parsons had been influenced by equilibrium ideas from physiology (Cannon), the system/environment-thinking of the Harvard physiologist Lawrence Henderson, and the duality of information and energy Norbert Wiener had proposed. From these materials he developed a sociological systems theory. Social systems are related either to the internal environment of other social systems or to external non-social environments (psychic, biological, cultural environments). Furthermore they differ in the way they refer to time: they are either oriented towards realizations in the future or to need satisfactions in the present (*instrumental* or *consummatory*). From these two distinctions internal/external and instrumental/consummatory Parsons derived four possibilities for the formation of systems: there are *adaptive* systems (combining external reference and future orientation, e.g. the economy), secondly systems which are specialized on *goal-attainment* (internal orientation, future, e.g. the polity), thirdly systems focused on *integration* of system elements (internal orientation, present time, e.g. the society conceived as a community), fourthly systems which

are responsible for the *maintenance* of long-term *patterns* (external reference, present time, e.g. cultural institutions in society).

There is one further aspect which Parsons adds to this elementary distinction of four types of systems. He distinguishes among these four system types systems in which a primacy of the *transfer of information* obtains (all cultural institutions and systems) from systems which are focused on transfers of energy (e.g. the adaptive economic system). Information-rich systems *control* energetical systems. These, on the other hand, are thought as *conditioning* factors which limit the scope of information-rich systems. This argument was taken from Norbert Wiener and Parsons derived from it a bidirectional hierarchy of conditions and control which interrelated all types of systems.

On the basis of these elementary distinctions Parsons worked for further three decades on a social theory which identified in any concrete social system these four universal functional aspects (adaptation, goal-attainment, integration, pattern maintenance) which often constitute autonomous subsystems of the respective system. In an analogy to economics he then added input/output-analysis. Systems and subsystems are interrelated via the input and output of resources which are either the result or the precondition of ongoing system processes. Among these resources are the cognitive and motivational resources of participants, and the rights and values which are attributed to them. These different types of resources are transferred in exchange processes between systems. For analyzing these exchange processes going on between systems, without which systems would never be able to procure the resources they need for their functioning, Talcott Parsons created a theory about media of exchange.

Parsons started again with an analogy to economics in theorizing about media of exchange. He postulated that there is first of all *money* in its economic function as a medium of exchange, well-known to economists. Then he added *power* and argued that it is best

understood when analyzed as analogous to money, as an exchange medium which mediates the transfer of resources (decisions, support, responsibility etc.) important in political processes. And after having written theories for power and money, Talcott Parsons added further media of exchange for input/output-processes between systems, among which *influence* and *value commitments* play an especially prominent role on the level of societal exchanges.

In continuing this work on media of exchange between systems which he did for decades, Parsons affirmed once more the cognitive starting point of systems theory in the 1940s: Systems theory as an interdisciplinary endeavour making use of intellectual resources as well from the sciences as from the humanities, and which as such is always focused on strategies for comparing heterogeneous systems and diverse system processes.

Niklas Luhmann (1927-1998)

Niklas Luhmann's writings always presupposed what Parsons had done. But it is as well true that he started systems theory anew. For him the system/environment distinction as inspired by Ludwig von Bertalanffy's theory of open systems was a much more important starting point than it was for Parsons. Whereas for Parsons the environment of a social system always consists of other systems, in Luhmann a phenomenological understanding of *environment* is far more prominent, which looks at the *difference* between system and environment, environments being structured in a completely different way than is the case in systems. *Order from noise*, the formula of Henri Atlan, Luhmann later on very often cited, gives a good idea of concepts of environment which look for contrasts and for differences and not for a simple plurality of other systems.

From the start, complexity was another central term in Luhmann. Systems process complexity, they arise by establishing and stabilizing a complexity difference towards their

environments. As is the case in Norbert Wiener and Gregory Bateson, systems for Luhmann are systems consisting from communications, and as such they are based on a way of processing informations which Luhmann calls *meaning*. Meaning is formally similar to information as it is based on something being a selection among plural alternatives. But what is characteristic of meaning and thereby constitutive for social and psychic systems, as the two types of systems making use of meaning, is that the alternatives not chosen are still remembered. One can come back to them, one can criticize selections in pointing to the alternatives which were available, one can write history on the basis of this dual structure of meaning.

For Luhmann, too, systems have a functional orientation. They specialize on certain problem solutions characteristic and constitutive of them. But he completely refrains from a finite catalogue of basic functions which have to be dealt with everywhere. Instead, every system is conceived to be singular in fulfilling the functional need which somehow was the catalyst around which the process of system formation came about as a historical and a contingent process. Sport, for example, is a global function system in present-day world society. But this system formation is a contingent event based on the improbable synthesis of very heterogeneous traditions (the hunting and riding traditions of the European nobility, boxing and wrestling as popular amusements in early modern Europa, ball games in English public schools, the gymnastics of Northern Europe and so on). On the basis of examples as this one can understand that for Luhmann modern society consists from huge and global function systems for economic relations, science, religion, law, intimate relations – and for a number of other functional problems in communication. Functional differentiation is the guiding principle of differentiation in contemporary society.

The further composition of the theory then was done by work on three theories which were added to the theory of social systems. There is a theory of sociocultural evolution, which

is conceived as a neodarwinist theory which analyzes how structure formation is possible on the basis of chance events. Secondly, Luhmann reformulates the Parsonian theory of media of exchange which mediate input/output-processes between systems as a theory of communication media which are conceived as being internal to function systems. These communication media are effect mechanisms. They are based on symbols which are thought to be effective in communication – e.g. symbols of money, power, truth or love -, and which as such effective symbols motivate other social actors to do something they would not have done without this effective use of symbols. In this version of the theory there is no exchange implied as communication is not understood as an exchange process. Thirdly, Luhmann works out a differentiation theory which embeds the empirical core diagnosis of functional differentiation into a more general theory of forms of system differentiation, among them segmentation and stratification. The guiding idea is once more to have an instrument for doing comparative research on social systems. Different historical formations can be compared in looking at the forms of system differentiation which are dominant in them.

There arose a further shift in the foundations of systems theory in the late 1970s by a new interdisciplinary import. Luhmann adopted the theory of autopoiesis proposed by Humberto Maturana and Francisco Varela which differs from the Bertalanffy tradition of open systems in looking at systems (e.g. cells) as being completely closed on the basis of their own production processes. Whatever they consist from – elements, structures, processes, boundaries -, systems are conceived to produce all their elementary constituents by their own production processes. Luhmann connected this hypothesis to communication theory. He then described social systems as autopoietic communication systems which always produce and reproduce a specific type of communication (e.g. payments in the economy, published truth claims in the social system of science) and which do this only on the basis of processes internal to the system. At the same time he held to the primacy of the system/environment-

distinction. Regarding autopoietic systems this means that for them, too, it is true that they only can continue their processes of production and reproduction of their components if they incessantly observe their relevant environments and generate informations instructive for their production processes on the basis of these observations.

Systems Theory Today

Systems theory continues in its two variants. As general systems theory, primarily influential among some biologists, chemists, physicists and mathematicians – and finding an important institutional place in the Santa Fe Institute, today. Secondly as paradigm of sociological theorizing and research, linked to the writings of Talcott Parsons and Niklas Luhmann. As a sociological paradigm it is attractive because of its universalism, conceiving a multi-faceted approach to the analysis of social systems which in the plurality of theoretical approaches it brought about promises to be applicable to the whole range of problems relevant for sociology.

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See also Comparative Method, Complexity, Functionalism, Self-Regulation

Further readings

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