INTERNATIONAL CONFERENCE ON ENGINEERING DESIGN

ICED ´93

THE HAGUE, AUGUST 17-19, 1993

FROM SOLUTION-DESIGN TO PROBLEM-DESIGN: SYSTEMS THINKING IN DESIGN THEORY

Wolfgang Jonas

ABSTRACT

The paper presents reflections about the development of design theory. Basic idea is the broadening and completion of cybernetics of control systems by the emerging theory of self-organizing systems ("2nd order cybernetics"). The concept of *problem* serves as an example for illustration.

INHALTSANGABE

Es werden Überlegungen zur Weiterentwicklung von Entwurfstheorie präsentiert. Der Grundgedanke ist die Erweiterung der Kybernetik der Regelsysteme durch die Theorie der Selbstorganisationssysteme ("Kybernetik 2. Ordnung"). Der *Problem*begriff dient als Beispiel zur Illustration.

1. INTRODUCTION

Engineering design theory is - for the most part - based on the cybernetic paradigm which is the platform that supports the *normative* methods in the so-called "Hansen-tradition" ([i]). VDI 2221 ([ii]) is the final "monumental" ([iii]) manifestation of this way of thinking. Approaches claiming to *describe* the cognitive process are also mainly based on the technical metaphor of the control circuit ([iv]). AI-approaches ([v], [vi]), the latest attempts - for the time being - to formalize the design process, perpetuate this tradition of necessity.

This is done in spite of even Norbert Wiener´s warning ([vii]) to extend cybernetic approaches into psychological and sociogical fields. He explained this position with the fact of the unavoidable integration of the observer and the observed. We are entangled in complex relations which we will never be able to observe from "outside" but always from specific interior points of view. Cognition from an "objective" standpoint is impossible; the convenient separation of subject - object does not work any more. The psychological aspect of Wiener´s warning concerns the above mentioned attempts to describe the *cognitive process*. I am more interested in the *sociological process* of design which is largely left aside in theory. The concept of problem, except for very few authors hardly problematized up till now ([viii]), will serve me as a peg to hang my considerations on.

The present situation, socially, economically and ecologically best described by the universal concept of *crisis* is neither result of "destiny" nor of (bad) planning, but it is the materialized manifestation of complex social processes of acting and communicating in which we (as designers and consumers) are closely involved. They are not centrally controlled; they can not even be controlled but at best influenced in certain points. It is necessary to analyze these processes more closely. Theoretical background is the extension of the theory of externally controlled equilibrium systems towards the dynamic evolutionary theories of living systems. Their origins lie in Prigogine´s non-equilibrium thermodynamics ([ix]), Eigen´s and Schuster´s theory of "hypercycles" ([x]), Maturana´s ([xi]) und Varela´s ([xii]) "autopoiesis" theory, and Heinz von Foerster´s "operative epistemology" (2nd order cybernetics) ([xiii]). An important development is the sociological systems theory, describing psychological and social processes as interactions of self-organizing units ([xiv]). Systems thinking of that kind implies: there is no central control but only perturbation of systems. Coordination is a matter of negotiation, done in "intersystemic discourses" between autonomous subsystems ([xv]). Cybernetic planning theory disparagingly calls this "muddling through".

2. THE LINEAR SCHEMA: PROBLEM -> SOLUTION

This is the way of thinking in every-day life, in design and even in design theory. Sometimes designers like to see themselves, according to H.A. Simon, as "general problem solvers". Simon defines problem solving as a "change of representation": to solve a problem simply means to formulate it in a way that the solution becomes transparent. This way of thinking in the the logic of cause and effect implies the illusion of external control, of final solutions, even of optimal solutions. It is based on the assumption of a temporaryly fixed hierarchy of needs and a fixed, formalized problem. The problem thus gains an "ontological" status and has not to be analyzed any more. Engineers, when claiming for the non-normativity of their acting often found it on arguments like these.

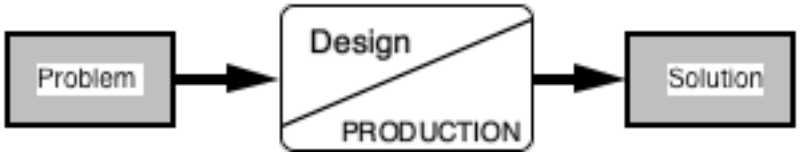

Fig. 1: The linear schema of problem and solution.

The discrepancy between *control systems* (technical objects) and *living systems* (e.g. the cognitive process of design, the social process of designing in a team, the social process of the dynamics of needs etc.) is suppressed. The synthesis of technical and living systems into *sociotechnical systems* ([xvi]) and its consequences with respect to the problem solving process is not recognized.

3. THE CYCLIC SCHEMA

Designing (Engineering Design and Industrial Design) is still acting as if the primary aim were products in their function as *bearers* of utility value (function) and communication value (meaning). But the real aim - as market dynamics with their inherent pressures show - is their function as *accelerators* of the production-consumption-cycle. Their materiality is a by-effect in this context. The most important function lies in the quick creation and short-term satisfaction of the feeling "want-to-have". The following short term of really having is only a transition stage leading to the renewed "want-to-have" of the subsequent model. Thus we produce temporary "Eigenvalues" in the permanent communicative process. Being "solution" means the guarantee of continuability; the products themselves are widely arbitrary materializations ([xvii]).

The continuous *problem of existence* of the economic system is central ([xviii]). As it is unsolvable as a whole, it is separated into operationalized purposes by selecting possible actions out of the "problem space" (which, at the same time, is the actual "solution space"). It is the task of marketing to furnish this kind of solvable problems in ever increasing frequency. This comprehension of solution is essentially convergent, more and more excluding alternatives. The field of existing solutions determines the potential field of feasible problems.
Cybernetic methods are able to optimize solutions *inside the given problem frame*. We do not reflect this limitation but provide the "solutions" and are surprised (or not, as there is no time) that they turn into new "problems" so rapidly. Becoming a problem again is the most important function indeed, as the continuity of the communicative process is at stake. It seems plausible to speak - in the marxist sense - of the *Verdinglichung* (materialization) of social relations in the *Warenform* (form of wares). From there it is not far to object *fetishism*. Von Foerster speaks more neutrally of objects as "tokens for (Eigen-) behaviors".

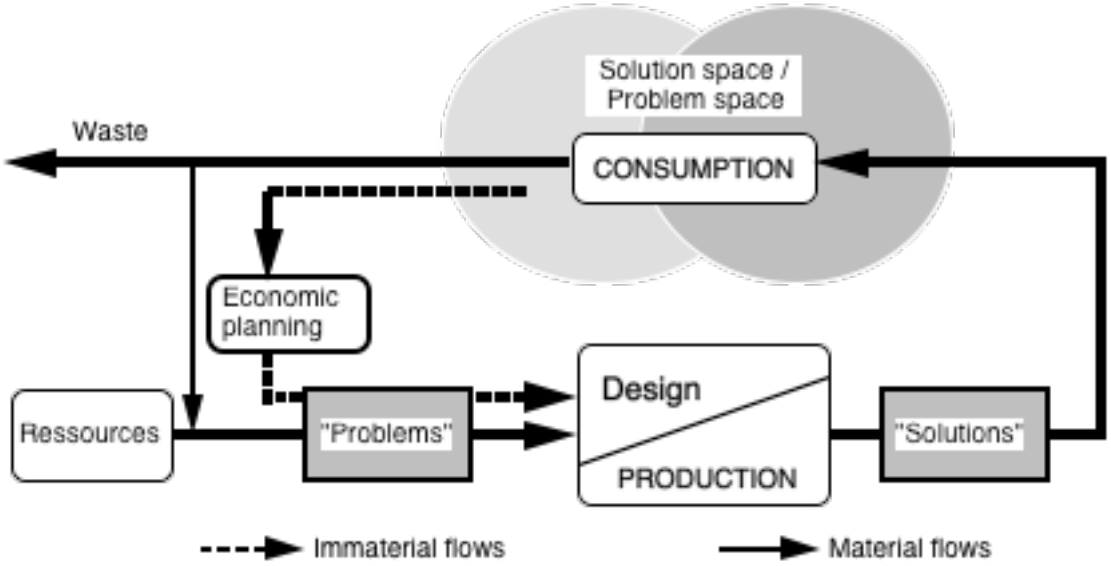

Fig. 2: The cyclic schema of production and consumption. Design as heteronomous element.

Design has the function of an amplifier in this flow. Thus the implicit general question of conferences like this logically is: how can design become more effective in its function in the global economic competition (for the most part Europe vs. USA / Japan). It seems to be a slightly tedious perspective for the discipline; and a proof for its heteronomy. But on the other hand - maybe - a chance for changes (e.g. de-materialization and deceleration of the cycle), for the immaterial circulation of capital is essential and not the circulation of goods.

4. DESIGN AS SYSTEM

The "solutions" of these "problems" become more and more optimal by means of cybernetic methods, at least if they are regarded in isolation. But why does the state of the world deteriorate so rapidly nonetheless? My hypothesis: because problems, as temporary events in the cyclic schema of production and consumption are not reflected carefully enough. Bruce Archer stated even in 1965 ([xix]): "There are plenty of good designers who have no difficulty at all in producing the right answers, if only they are asked the right questions." It seems necessary to *interrupt* the blind self-referential cycle and to exert an influence on the problem definition. I call this "*Problem-Design*". The necessary consequence is that design needs a disciplinary self-consciousness based on *values* for orientation in the chaotic problem space. I quote Norbert Wiener again, who is normally used by the advocates of "non-normative" rationality: "The answer, of course, is to have a society based on human values other than buying or selling. To

arrive at this society we need a good deal of planning and a good deal of struggle - which, if the best comes to the best, may be on the plane of ideas, and otherwise - who knows?"
The - maybe utopic - objective is: design no longer as *heteronomous functional element* but as *autonomous subsystem* in the social system. The way towards *dialogue capability* as a prerequisite for *meddling* of design leads via *self-reflection* and *theory-building*. Theory-designs of the past are attempts of this kind, but they were not far-reaching enough as their limitation (in engineering design) and their limited tenability respectively (in industrial design) have shown.
Up till now there is mainly a *negative adaptive dynamics* to economy in the sense of a negative feedback-loop. The self-reflexive design cycle in fig. 3 ([xx]) allows system formation and thus yields a prerequisite for entering into inter-systemic discourses with other social subsystems. This could create a sort of *positive adaptive dynamics* in the sense of an active exertion of influence. Examples of this kind of dialogue capability: physicists make statements on the sense / senselessness of manned space-flights, physicians on the dangers of nuclear energy, etc. and they are noticed by the public. Why seems the idea of designers making statements e.g. on the future of the automobile so bizarre? A conference like this could contribute to finding answers to questions like this if only the heteronomy of the discipline would be made a matter of discussion.

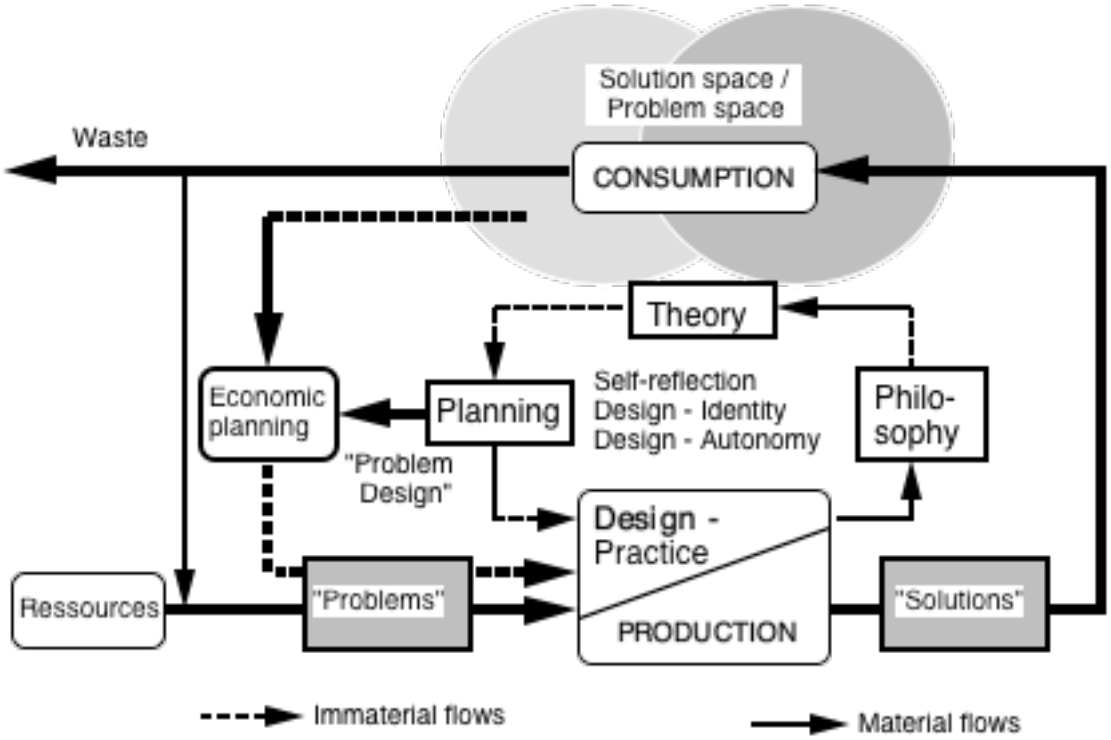

Fig. 3: Design as autonomous system with the ability to bring an influence to bear.

5. SUMMARY

Design should gain influence on problem definition ("*Problem Design*"). Problems are not given but made. It is more important to have an understanding of the complexity of the problem field than producing beautiful appearances of "solutions". Divergence is better than convergence. Von Foerster: "Act always so as to increase the number of choices." This opens the way to the urgently needed *reduction of intensity* and *deceleration of material- and energy-flows* and its replacement with *information-flows* (to be created by designers) respectively ([xxi]). Product *avoidance* could become an important design goal.
General objective is the increased *flexibiliy* of artifacts in the context of other technical and - above all - social systems, the ease of *adaptation* to changing goals and needs. This results

immediately from the in principle uncontrollable dynamics of sociotechnical systems. Cybernetic methods have to be applied while carefully accounting for their spatial and temporal limitations. The seeming chaos of self-organization outside the fixed problem frame does not make systematic problem solving unnecessary but even more important. The next step is the extension towards theories of dynamic, nonlinear, fluctuating, evolutionary systems. An objective of such efforts is the strengthening of disciplinary autonomy, especially with regard to economy. Holt and Radcliffe present an approach in this direction of self-reflexive theory work on the level of design teams ([xxii]). This has to be generalized for all levels of design. My own approach presents the proposal of a dynamic multi-level system, linked to the cycle of product communication ([xxiii]).
We constitute our realities in the biologically, socially, and culturally determined process of perceiving - acting - thinking. *Nothing* in it is "given" as an ontological fixum, but everything is potentially subject of designing. Thus, according to "2nd order cybernetics", a future design theory has to be able to explain its own generation (theory design).

BIBLIOGRAPHY

([i]) Hales, C.; Wallace, K.M. "Systematic Design in Practice", Proceedings of ICED 91, Zürich 1991 pp 105-112

([ii]) VDI 2221 "Methodik zum Entwickeln und Konstruieren technischer Systeme und Produkte" (Entwurf), VDI-Verlag, Düsseldorf 1985

([iii]) Gregory, Sydney "A monument", book review: Pahl, G. and Beitz, W. Engineering Design, London 1984 (Original: Konstruktionslehre, 1977), Design Studies Vol. 7 No 1, Jan. 1986

([iv]) Rutz, Andreas "Konstruieren als gedanklicher Prozeß", Dissertation, TU München 1985

([v]) Simon, Herbert A. "Die Wissenschaften vom Künstlichen", Kammerer & Unverzagt, Berlin 1990, Original: "The Sciences of the Artificial", Cambridge, Mass. 1981

([vi]) Krause, F.-L.; Lehmann, C.M.; Schlingheider, J. "Changes of design methodology in the view of computer-aided product gestaltung", Proceedings of ICED 91, Zürich 1991 pp1012-1017

([vii]) Wiener, Norbert "Kybernetik. Regelung und Nachrichtenübertragung in Lebewesen und Maschine", Rowohlt, Reinbek bei Hamburg 1968, Original: "Cybernetics or control and communication in the animal and the machine", 1948, 2. Auflage 1961

([viii]) Schregenberger, Johann W. "Probleme als Konstrukte", Proceedings of ICED 83, Kopenhagen 1983 pp 524 - 527

([ix]) Prigogine, Ilya "Vom Sein zum Werden", Piper-Verlag, München 1979

([x]) Eigen, Manfred; Schuster, P. "The Hypercycle. A Principle of Natural Self-Organization", Springer-Verlag, Berlin Heidelberg New York 1979

([xi]) Maturana, Humberto R. "Erkennen: Die Organisation und Verkörperung von Wirklichkeit", Vieweg, Braunschweig 1985

([xii]) Varela, Francisco J. "Kognitionswissenschaft-Kognitionstechnik. Eine Skizze aktueller Perspektiven", Suhrkamp, Frankfurt / M. 1990

([xiii]) von Foerster, Heinz "Sicht und Einsicht: Versuche zu einer operativen Erkenntnistheorie", Vieweg, Braunschweig 1985, Original: "Observing Systems", Seaside, Cal. 1981

([xiv]) Luhmann, Niklas "Soziale Systeme. Grundriß einer allgemeinen Theorie", Suhrkamp, Frankfurt / M. 1984

([xv]) Willke, Helmut "Systemtheorie entwickelter Gesellschaften. Dynamik und Riskanz moderner gesellschaftlicher Selbstorganisation", Juventa Verlag, Weinheim und München 1989

([xvi]) Ropohl, Günter "Eine Systemtheorie der Technik. Zur Grundlegung der Allgemeinen Technologie", Hanser, München 1979

([xvii]) Jonas, Wolfgang "Design as Problem Solving? Or: Here is the Solution - What was the Problem?", in Design Studies Vol 14 No 1

(xviii) Luhmann, Niklas "Zweckbegriff und Systemrationalität. Über die Funktion von Zwecken in sozialen Systemen", Suhrkamp , Frankfurt / M. 1973, 5. Auflage 1991

(xix) Archer, L. Bruce "Systematic Method for Designers", published by The Design Council, London 1965

(xx) Maser, Siegfried "Einige Bemerkungen zum Problem einer Theorie des Designs", Selbstverlag, Braunschweig 1972

(xxi) Zec, Peter "Informationsdesign. Die organisierte Kommunikation", Edition Interfrom, Zürich 1988

(xxii) Holt, J.E.; Radcliffe, D.F. "Learning in the organizational and personal design domains", in Design Studies Vol 12 No 3

(xxiii) Jonas, Wolfgang "Design - System - Theorie. Überlegungen zu einem systemtheoretischen Modell von Design-Theorie", unveröffentlichtes Typoskript, Wuppertal 1993

Dr. Wolfgang Jonas
Fachbereich Design
Bergische Universität Gesamthochschule Wuppertal
Hofaue 35-39
D-5600 Wuppertal 1
Germany