Wolfgang Jonas

Systems Thinking in Industrial Design

Proceedings of System Dynamics '96, July 22-26, 1996, Cambridge, Massachusetts

1) Introduction: System theory as a framework for design research

An earlier work of the author (JONAS 1994) proposes a *systems theoretic framework for design*. It seems to be possible to describe design as a cylic multilevel (society, sub-systems, companies, teams, individuals) communication process of production and consumption with partly deterministic / controllable and partly self-organizing areas.
It was possible to verify certain hypotheses comprising elements in two adjacent levels (or better: to reproduce certain observations) by means of system dynamics (Stella II Version 2.2.2). Emergence- and attractor-phenomena could be visualized.
Theory-building is continued (it seems necessary for design to avoid adopting a brand-new stylish theory every decade), but *without* using simulation tools, at the moment. It is much more important, to work out the conceptual construction in more detail, using - among others - advanced sociological concepts based on autopoiesis theory (LUHMANN 1984), before one can begin to verify them. Otherwise, that is my impression, one transforms common-sense-knowledge into simulation models, tunes them until similarities to observed reality become obvious, and will be satisfied. But the true outcome is rather poor.
I doubt (and ask the question / put to discussion) whether system dynamics can be helpful to *build* theories, at least in the humanities (which I consider design belongs to). There is no doubt that they are useful to *apply* theories, to operationalize them towards methods.

2) First-generation design methods

The "design methods movement" of the 60s and early 70s was strongly influenced by cybernetic thinking which had proven its efficiency in the big army- and NASA-projects, i.e. in optimizing means to transfer a *well-defined* problem into a solution. The assumptions were: We know what the problem is, we know what people want, or even: what is good for them, we have the adequate means to achieve at solutions. JONES (1988) characterizes this narrow-minded expert attitude: "We are here to help the others: what the others are for I´ve no idea." It did not work in design practice, respectively it survived in project management, far away from the creative process.
In the early 70s there was a great disillusionment among leading methodologists: Christopher ALEXANDER (1971) answered the question as to the important areas of future research in methodology: "I would say forget it, forget the whole thing." Horst RITTEL (1972) states that "... first-generation methods seem to start once all the truly difficult questions have been dealt with already." And John Christopher JONES (1977) complained: "They all wanted a complete recipe ... Many people wanted this and perhaps all students want it all the time. But I feel one should resist any such thing if one´s to continue living. ... I found a great split had developed between intuition and rationality, reason." Even Bruce ARCHER (1979) confessed: "... I wasted an awful lot of time in trying to bend the methods of operational research and management techniques to design purposes." By the way: In the East (I´m teaching at an institution of the former GDR) they continued developing 1st generation methods as if nothing had happened (FRICK 1982). And indeed: nothing *had* happened (comparable to the changes in the West in the late 60s) and nothing happened until 1989.
The (Western) designers of the 80s abandoned any rationalistic ways of problem-solving. They created pretty things and fetishes and presented themselves as sort of egocentric artists, which in fact was also a step of liberation / emancipation from the great but unachievable moralic aims (to work for a better society) of the profession in the era of functionalism. This is still working. Design is a factor of growing importance in the production-consumption cycle, but there are more and more questions whether this should be all.

3) New systems approaches: from cybernetics to 2nd order cybernetics

Today´s keywords to describe the situation are: *Complexity, fuzzyness, non-predictability, pluralism in values, etc.* There are neither "real" needs, nor "true" solutions to problems any more. Problems are closely interconnected in many fields instead. The view of society as a functionally differentiated, mainly *self-organizing* system requires considerations towards an *enlightened and broadened conception of rationality* which allows to deal with non-economic, non-quantifiable aspects of practice again.
Meanwhile - parallel to the changes mentioned - several new developments emerged in science. In my view, one of the most important advances towards a re-naturalization of epistemology (see QUINE´s request) was Heinz VON FOERSTER´s (1979) formulation of *2nd order cybernetics* which -in contrast to 1st order cybernetics dealing with observed systems - is interested in *observing systems in their interaction with the observed.* Objectivity, one of the most honoured scientific principles, seems to support our cognitive blind spots by requiring that the characteristics of the observer must not affect the description of his or her observations. His plain but far-reaching question was: "... how would it be possible to make a description in the first place if not the observer were to have properties that allows for a description to be made?" From this it appears to be clear that social cybernetics must be a non-hierarchic second-order cybernetics - a cybernetics of cybernetics. The *autonomous* observer who enters the system is a stakeholder and thus shall be allowed to stipulate his or her own *purpose*. If we fail to do so somebody else will determine a purpose for us. Moreover, if we fail to do so, we shall provide the excuses for those who want to transfer the *responsibility* for their own actions to somebody else: "I am not responsible for my actions; I just obey orders."

4) Relevant topics in design practice

Design tasks have changed from almost professional issues to *ill-defined* problems where the old approach does not seem satisfactory any more. This is - among others - due to a functional shift in design from satisfying needs (until the 60s, in the East delayed until ´89: a rather simple job), via stimulating needs (in the 70s and 80s: a situation provoking great controversies) towards a complex mix of satisfying / stimulating / designing / negotiating needs in the 90s. The leading researchers involved in the development of 1st generation design methods seem to have anticipated the upcoming new requirements almost 20 years in advance:
RITTEL (1972) states that "... there is no professional expertise that is concentrated in the expert´s mind, and ... the expertise used or needed, or the knowledge needed, in doing a design problem for others is distributed among many people, in particular among those who are likely to become affected by the solution - by the plan - and therefore one should look for methods that help to activate their expertise. Because this expertise is frequently controversial, and because of what can be called ´the symmetry of ignorance´ - i.e. there is nobody among all these carriers of knowledge who has a guarantee that his knowledge is superior to any other person´s knowledge with regard to the problem at hand - *the process should be organized as an argument.*"
JONES (1977): "I´m just realising that if designing is applied to life, not just to products, systems and software, *there has to be more politics (in the athenian sense)* (two-way processes) and less planning, if designing is not to become tyranny."
JONES (1984): "*Creative collaboration* is perhaps the main challenge of our time. ... The first practical step to unblocking, to being free to be inventive, and collaborative, is to widen, and to overlap, our job specifications, our roles. Once that happens the whole context begins to become mobile."
As larger groups begin to collaborate in design, we need not only looser roles but more public ways of thinking aloud. More visible design processes so that everyone can see what is being decided, and why, *before*, not after, the main decisions are made. Collaboration before concept-fixing is perhaps the main strength of the required new design methods. The other strength is to provide means of *un*learning, publicly, with changing, not fixed, self-images.
We need - it sounds paradox - a democratic instrumentarium for *participatory socio-technical planning in a situation where planning in the original cybernetic sense is impossible.*

5) Towards second generation design methods

Today again, as in the 50s and 60s, especially planning- and management sciences (e.g. ULRICH / PROBST) and systems engineering (e.g. CHECKLAND / SCHOLES) are aware of the necessity of new approaches. Methods are being developed for this purpose that act on the level of 2nd order cybernetics.
Design research, as 40 years ago, seems to be a bit late in adopting new systems thinking. Nigel CROSS (1993) states that "... *emergence* emerged as a key concept that ... may be fundamental to design research more generally. ... Emergence is the concept of implicit structure arising from other, explicit structures, and is a matter not simply of pattern recognition but of pattern *definition* by the designer during the evolution of problem requirements and solution concepts. A similar distinctive feature of design was thought to be that of the *exploration*, rather than search, of problem spaces. Search is an easier concept to programme, since it is concerned to identify a particular solution whereas exploration is concerned with finding something that can only be identified as interesting or valuable once it has been found."
What is / can be the new role (more than just an auxiliary function) of design in this context? Klaus KRIPPENDORFF's programmatic statement (1994): "*Industrial designers are responsible for creating the affordances for stakeholders' meaningful involvement with artifacts and through them with each other.*" seems rather promising, because it specifies a professional field unoccupied by any other discipline. Design (as an academic discipline) can only survive, if it will reflect and redefine its *specific function* which is a *integral* one dealing with the *negotiation of meaning* and the *moderationof problem-solving processes*. Moderation implies a certain modesty; while of course on the other side there is a characteristic of the second generation which is not so modest, that of lack of respect for existing situations and an assumption that nothing has to continue to be the way that it is.
To sum up: Contributions to problem-solving should be expected by the integration of existing expert knowledge rather than by more detailed investigation. Separating the design process into ANALYSIS (What is the problem?), PROJECTION (How do we want to live?) and SYNTHESIS (What do we need for this?), new methods emphasize the first two steps, supporting function-oriented "*problem design*" instead of ultimate, object-oriented "solution design". They examine the system in which this happens and aim at contexts and scenarios, not products.
New methods are open, interactive, transparent, supporting teamwork, interdisciplinarity and public partizipation through discourse-supporting communicative structures. Scenario-techniques are a promising methodic guide for future-oriented problem solving.
The general aim is to widen the scope of subjects of design work thus helping design to become a more competent and responsible partner in the network of future-shaping disciplines.

6) For example: Sensitivity Modelling (SM-Tools)

SM-Tools step	activity	supported by Stella II V 2.2.2 ?
system description	general guidelines for system-building	no
set of variables	20-40 descriptors of the system	no
criteria check	check of systemic relevance of variables	no
cross-impact analysis	potential impact of variables on each other	no
role of variables	active, reactive, critical, buffering	no
dynamic network	variables and relations, analysis tools	**yes**
partial scenarios	parts of network, functional relations	**yes**
simulation	interactive simulation of partial scenarios	**yes**
system evaluation	viability as to set of "biocybernetic rules"	no

Table: SM-Tools steps in comparison with Stella II (V2.2.2)

Based on these considerations a new method is presented (SM-Tools: Sensitivitätsmodell Prof. Vester) that concentrates on the above mentioned phases of ANALYSIS and PROJECTION. It deals with the description and analysis of complex problem fields, providing a *working language for structured communication in interdisciplinary teams*. A rough but complete model of the system under consideration has to be established. Guiding idea is the concept of living systems leading to the aim of viability. Though simulation is possible, it does not aim at prognosis, but at understanding the dynamics of a system, its sensitivity as to perturbations and interventions, thus supporting realistic ways of PROJECTION. It works with cognitive maps based on Petri-nets, keeping a relational database in the background. It is completely interactive (this brings the quality of a 2nd order method) and problem-oriented, the steps do not necessarily have to be performed in a sequential way.

7) References

Alexander, Christopher (interviewed by Max Jacobson) "The State of the Art in design Methods" in: DMG Newsletter, 5 (3) 1971, pp 3-7
Archer, L. Bruce "Whatever Became of Design Methodology?" in: *Design Studies* Vol 1 (1) 1979 pp 17-18
Checkland, Peter; Scholes, Jim *Soft Systems Methodology in Action* John Wiley&Sons, Chichester 1990
Cross, Nigel (ed.) *Developments in Design Methodology* John Wiley, Chichester 1984
Cross, Nigel Report: Second international round-table conference on computational models of creative design, 6-10 December 1992, Heron Island, Queensland, Australia
In: *Design Studies* Vol 14 (3) July 1993 pp 344-346
von Foerster, Heinz "Cybernetics of Cybernetics" in: Krippendorff, Klaus (ed.) *Communication and Control in Society* Gordon and Breach, New York 1979
von Foerster, Heinz *Observing Systems* Seaside, Cal. 1981
Frick, Rolf *Designmethodik - eine Einführung für Studierende* Hochschule für industrielle Formgestaltung Halle, 1982
Jonas, Wolfgang *Design - System - Theorie. Überlegungen zu einem systemtheoretischen Modell von Design-Theorie* Verlag Die Blaue Eule, Essen 1994
Jones, John Christopher "How my Thoughts about Design Methodology have Changed During the Years" in: Design Methods and Theories 11 (1) 1977 pp 50-62
Jones, John Christopher "Softecnica" in Thackara (ed.) 1988 pp 216-226
Krippendorff, Klaus "Redesigning Design. An Invitation to a Responsible Future" University of Pennsylvania, Philadelphia, June 1994
Luhmann, Niklas *Soziale Systeme. Grundriß einer allgemeinen Theorie* Suhrkamp , Frankfurt / M. 1984
Rittel, Horst W.J. "Second-generation Design Methods" in Cross (ed.) 1984 pp 317-327 (originally published 1972)
Stella II *Systems Thinking, Experimental Learning Laboratory with Animation* High Performance Systems, Hanover NH 1990
Thackara, John (ed.) *Design after Modernism. Beyond the Object* Thames and Hudson, London 1988
Ulrich, Hans; Probst, Gilbert J.B. *Anleitung zum ganzheitlichen Denken und Handeln* Paul Haupt, Bern und Stuttgart, 1988, 3. Aufl. 1991
Vester, Frederic *Sensitivitätsmodell Prof. Vester. Ein computerunterstütztes Planungsinstrumentarium zur Erfassung und Bewertung komplexer Systeme* Studiengruppe für Biologie und Umwelt GmbH, München 1993

The author:
Prof. Dr. Wolfgang Jonas
Hochschule für Kunst und Design
Postfach 200 252
D-06003 Halle / Saale, Germany
E-mail: 100113.3507@compuserve.com