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N-th order design?

Systemic concepts for research in advanced methodology

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1 Why design research?

Ranulph GLANVILLE (1980) is rising the question and continues:

"The answer to this is, I think, rather shocking. There is, in principle, no reason at all. It is merely a matter of faith. The faith is rather that of the patient attending psychotherapy, of the person who believes that by becoming more aware of himself he will learn to perform better. ... Thus, given the (hard to justify but generally held) view that knowledge improves things, if our knowledge derives from research, it is surely sensible to acquire knowledge of research in order to improve research."

Faith in the necessity of design research is growing (again). Since the late 1980s discussions are emerging as to design´s ability to cope with new subjects in broader contexts. BUCHANAN´s „Myth and Maturity" (1990) is one of the key texts. In Europe the conferences ´94, ´95, and ´96 at UIAH Helsinki dealt with questions of responsibility, complexity, and methodology in design. In Germany there is a delay in this discourse, except maybe related to ecological themes in a narrow sense. Views as presented here are still provoquing controversial discussions revealing the high sensitivity of the issue. My article starts with a critical review of - more or less methods-oriented - papers from BUCHANAN, GOLSBY-SMITH, and MARGOLIN from the years 1992-1996. The focus of interest is the *concept of system* used there and the question whether a more elaborate concept can support the suggested developments for the discipline. I agree with their diagnosis of the current situation as well as the overall direction. BUCHANAN´s contribution is central regarding theory construction. MARGOLIN and GOLSBY-SMITH are building on his ideas in addressing further aspects and giving practical examples for extended design practice. Though claiming that his vantage point is practical rather than theoretical, GOLSBY-SMITH´s paper reveals some links to my own approach. The primary intention is research *for* design, not research *about* design (MARGOLIN introduced - and drew back - this distinction, 1996b). On the other hand sustainable research for design will always be, at least in part, research about design. The paper should be recognized as a flash at the evolving outline of a research program in methodology, a structure that has to be fleshed out in many areas and maybe changed. For the theoretical base see JONAS (1994, 1997, 1998).

2 Recent references to systemic approaches

Buchanan´s four orders of designing. The author refers to the notion of „wicked" or „ill-structured" design and planning problems introduced in the late 1960s by RITTEL (1972) and others

who realized that the existing „1st generation methods" adapted from systems engineering and based on 1st order cybernetics were no longer suitable for the new problems in pluralistic societies with confusing information, conflicting values, highly complex ramifications, etc.

BUCHANAN (1992: 14):

"... The linear model of design thinking is based on determinate problems which have definite conditions. The designer´s task is to identify those conditions precisely and then calculate a solution. In contrast, the wicked-problems approach suggests that there is a fundamental indeterminacy in all but the most trivial design problems - problems where, as Rittel suggests, the ´wickedness´ has already been taken out to yield determinate or analytic problems."

He suggests that problems are increasingly wicked (1992: 15):

"... because design has no special subject matter of its own apart from what a designer conceives it to be. The subject matter of design is potentially universal in scope, because design thinking may be applied to any area of human experience. But in the process of application, the designer must discover or invent a particular subject out of the problems and issues of specific circumstances."

This contrasts with scientific disciplines, which are concerned with understanding the structures and laws that are necessarily embodied in existing subject matters. In my words: scientists describe *complexity*, designers reduce *contingency* by making decisions in highly complex environments. The description of *design as an integrative discipline*, referring to John DEWEY´s concept of science and technology as an art of experimental thinking, is essential for his further argument (1992: 5, 6):

"From this perspective , it is easy to understand why design and design thinking continue to expand their meanings and connections in contemporary culture. There is no area of contemporary life where design - the plan, project, or working hypothesis which constitutes the ´intention´ in intentional operations - is not a significant factor in shaping human experience."

He introduces a long-neglected term of technology, in Germany known as "Allgemeine Technologie" (ROPOHL), to support his view of *design as a liberal art* (1992: 18):

" ... design is slowly restoring the richer meaning of the term ´technology´ that was all but lost with the rise of the Industrial Revolution. Most people continue to think of technology in terms of its product rather than its form as a discipline of systematic thinking. ... Every liberal art had its own technologia or systematic discipline. ...

Design also has a technologia, and it is manifested in the plan for every new product. ... In this sense, design is emerging as a new discipline of practical reasoning and argumentation ... The power of design as deliberation and argument lies in overcoming the limitations of mere verbal or symbolic argument - the separation of words and things, or theory and practice that remains a source of disruption and confusion in contemporary culture."

He then introduces and works out his four orders of design (1992: 7, 8; also 1994): (1) the design of symbolic and visual communications: signs, (2) the design of material objects: construction, (3) the design of activities and organized services: strategic planning, and, as an expanding area, (4) the design of complex systems or environments for living, working, playing, and learning: systemic integration. The distinction between visual (1) and material objects (2) is, in my view, becoming more and more fuzzy and thus obsolete. The growing field of interfaces illustrates this objection. The further distinction between planning (3) and systemic integration (4) is not at all convincing; I see the two on different levels of categorization. E.g. communicative or material solutions can be based on highly systemic considerations. On the other hand there can be services designed in a very narrow, mechanistic sense, etc. Thus fourth order design is not a special subject field but a way of thinking which applies to all subjects. In

„Branzi´s Dilemma" (1994: 20, fig. 4) he extends the differentiation towards a matrix schema „formed from the fundamental *abilities of designers* and the closely related *disciplines of design practice*" which even increases confusion. Has communication nothing to do with judging, deciding, evaluating? Etc. And what does the location of different management theories in the rows related to the abilities mean (1994: 23, fig. 5)? In my view this schema is not very useful for practical purposes. He concedes (1992: 8):

"Reflecting on this list of the areas of design thinking, it is tempting to identify and limit specific design professions within each area - graphic designers with communication, industrial designers and engineers with material objects, designers-cum-managers with activities and services, and architects and urban planners with systems and environments. But this would not be adequate, because these areas are not simply categories of objects that reflect the results of design. Properly understood and used, they are also places of invention shared by all designers, places where one discovers the dimensions of design thinking by a reconsideration of problems and solutions."

To sum up my critique: BUCHANAN´s main contribution, regarding the building of a growing shared knowledge base for design, is his recognition and re-integration of methodologists as Horst RITTEL and John Christopher JONES, and, in a critical sense, also Herbert SIMON, into the evolutionary line of design thinking in the 20th century. My suggestion is to skip the four-order schema and make the distinction between *first- and second order design* according to the way the problem field is considered in the design process (with consequences as to the required competencies, tools, forms of cooperation, etc.). This would fit into RITTEL´s notion of *first- and second-generation methods*. His 1972 statement has lost nothing of its actuality:

"... first-generation methods seem to start once all the truly difficult questions have been dealt with already."

Golsby-Smith´s examples of third- and fourth order design. GOLSBY-SMITH´s programmatic vision (1996: 6) is:

„... a widening of influence of design outwards into the surrounding medium - the life of organizations in the modern world, or of governments and communities."

He tries to illustrate BUCHANAN´s concept with a project he is carrying out for the Australian government, the rewriting of the Income Tax Act. It deals with designing a flexible instruction for the permanent continuation and adaptation of the law. In my view there are parallels with the design of CI-guidelines for a big company. He explains (1996: 10):

"Hence, we view the act as an "information city", and the team´s design efforts as a kind of "information architecture"."

He introduces *third order design* by contrasting it to a possibly too reduced concept of first- and second order design (1996: 11; 8):

"In domains one and two, the designer adds value to the artifact, itself. ... The designer assumes that the product boundaries (i.e., the concept and content) are stable and defined. The form of the product is, as yet, unstable and undefined. In these first and second domains, the concept of design is a proxy for "shape" or "form" ..."

"... the enlightened industrial designer researches the market and its needs, the producing company and its processes of manufacture, as well as its market aspirations. ... In the case of document design , a third order designer ... now sees the document not as dead information, but as the catalyst to reduce uncertainty in human activity."

This should be normal design practice, in whatever order. More important (1996: 11):

"In the third order the designer decides that the client will benefit from an earlier intervention of design thinking, at a more strategic and crucial time. The value proposed by the designer becomes: "You will make a better product decision as a result of my leading you through the process of design." ..."

Fourth order design has to do with the question "Why?" and includes factors such as values and beliefs in a wider field of other related processes. It aims at integration so that the product does not operate in isolation, but within viable patterns. (1996: 14, 15):

"It is within the scope of a fourth order designer to understand and influence these connected processes - one of the passions and skills of the fourth order designer is integration and pattern. ...
... integration is not just a rational process of fitting things together like a giant jigsaw puzzle. It is also a process of discovering the energy by which things cohere and fit together."

He then introduces the concept of *system* as useful regarding the involvement of „people or communities". Its original use had been mechanistic, but (1996: 15):

"Of late, the word has been taken over by a "softer" set of intentions and has been used to describe ecological, holistic approaches to problems and the role of organizations."

Referring to CHECKLAND and SENGE he claims that these authors have moved *people* into the focus, and seem to have humanized the previously mechanistic notion of "system". In my view, the step towards „people" is short-sighted (JONAS 1998). It sounds pretty humanistic, but maybe it isn´t. Even CHECKLAND and SENGE go further towards underlying *structures*. GOLSBY-SMITH seems to realize this when he refers to (1996: 17):

""barometer" subsystems - activities which are de facto indicators of the health of the wider system. ..."

The further differentiation is highly promising: weakening the concept of purpose, describing system as conversation, conversation as creating systemic boundaries, stressing the function of purposes in a communicative process, etc. (1996: 19, 20):

"... we have sought alternatives to the biological model of a system and are exploring the model that a system is "a set of conversations around a shared purpose". ... It preserves the primacy of purpose without immediately prostituting it to outputs. Conversations have "purposes", but these are relational as much as output oriented. Furthermore, a purpose works in a conversation to constrain and set its boundaries - another key aspect of the notion of system. Conversations are ... explorations of themes.
... If the concept of "conversation as system" is at all viable, then clearly one of the key arts of working with systems will be the art of orchestrating conversations. ...
... so the outcome is less important than the process."

GOLSBY-SMITH foresees a further broadening of the subject with new opportunities arising from an emerging demand for design thinking in companies, public administration, etc. He suggests to conceive *management as design problem*. (1996: 22 - 25):

"... all have a common theme. They have found themselves, in whole or in part, in de facto design situations. In these situations, they have responded with analytical management tools that have not proved adequate, partly because these tools are predicated on a more structured situation than they now confront."

I fully agree with his final prediction that fourth order designers will find new applications and interests beyond traditional subject matter for design:

„The design community´s best preparation is, first, to understand this widening context for design; and, second, to explore and articulate the art of design within it."

Margolin´s approach towards global design. MARGOLIN (1996a) refers to BUCHANAN´s „Wicked Problems" and GOLSBY-SMITH´s examples as a "fruitful line of development" but criticizes that this "new vision of design practice" does not respond to the problems of our planet as a whole. (1996a: 23):

"This means marshaling all four domains of design practice in order to deal with problems whose definition much less resolution have thus far eluded everyone. ... The first step in this process is constructing a model of the world situation in order to identify problem areas. ..."

Starting with a short review of 19th century world models (Herbert SPENCER) he concentrates on Jay FORRESTER´s system dynamics approach used e.g. for the well-known world models developed for the Club of Rome. This is one (rather mechanistic, if regarded in isolation) tool from a growing box of systemic methods.

Two critical remarks in between: Firstly, according to BUCHANAN´s notion one could be tempted to call the missing area „5th order design". Consequently, intergalactic design might be called „6th order", and so forth ... Not very convincing, and, presumably, BUCHANAN thinks of fourth order design as the „ultimate" and would reject this inflation of orders. Secondly, MARGOLIN is using a rather simplistic dualism of concepts: equilibrium vs. expansion. Early systems theory was much influenced by perspectives emphasizing equilibrium and homeostasis indeed. In recent years, however, much more attention has been devoted to the analysis of *instability* (PRIGOGINE) and the concept of *autopoiesis* (MATURANA, VARELA). These new theories have carried systems thinking into a completely new realm, with exciting new possibilities. Organized complexity (dissipative structures, regions of minimum entropy) is possible only in systems far from thermodynamic equilibrium. Patterns of behaviour are neither stable nor periodic but show characteristics of „strange attractors". Dissipative systems import low entropy and export high entropy. E.g. the totality of living systems on planet earth is in a state of high non-equilibrium which is sustained by solar energy. Equilibrium in living systems means death and non-equilibrium does not necessarily mean quantitative growth. It means first of all the condition of emerging complex order. The crucial question is: how can the state of optimal non-equilibrium be maintained without wasting irretrievable resources and causing irreparable damage? MARGOLIN puts it that way (1996a: 28):

"It is easy to continue with stories of product research and development that are justified within this expansionist discourse by the promise of a better life. However, changing the terms of this discourse is not easy."

The central problem, according to Langdon WINNER (MARGOLIN 1996a: 28):

"For the trouble is not that we lack good arguments and theories, but rather that modern politics simply does not provide appropriate roles and institutions in which the goal of defining the common good in technology policy is a legitimate project."

I don´t know whether politics has to solve this problem, but I agree to reject the propagation of new values and appeals for ethics as not very promising. New ethics emerge from new practice, not vice versa. His approach, instead, is to develop design towards an *integrative discipline*, an *agency of intervention* which is able to contribute to these issues (1996a: 31, 32):

„Design is the activity that generates plans, projects, and products. It produces tangible results which can serve as demonstrations of our arguments for how we might live. ... The world expects new things from designers. That is the nature of design.

... Working with four domains, the designer or design team can locate a particular project in a context that may even change the project itself. When design is not limited to material products, designers can intervene within organizations and situations in a greater number of ways."

Addressing the existing core competences of design, he concludes (1996a: 32):

„By following this course, designers can seek through the art of demonstration to reconcile the best aspects of the expansionist and equilibrist models and thereby make an important contribution to the fruitful continuance of life on Planet Earth."

A last critical remark: Finally the very deficit that was stated at the start, that BUCHANAN´s four domains do not account for global problems, has been miraculously sorted out through the application of fourth order design thinking to global problems.

3 Design as systemic intervention

All three authors are more or less explicitly pleading for some sort of „soft" *systems approach*, strictly distinguished from the ugly „hard" theories of the past. The general aim is to realize and develop the integrative potential of design in order to secure the survival of the discipline. *Discourse / design thinking* as the key modus operandi seems to be the central theme. But how to initialize the necessary circular relation of action and reflection called *learning*? Design thinking or „the art of strategic conversation" (VAN DER HEIJDEN 1996) is not a design specific competence but rather a conversational meta-discipline. Designers will have to take the risk and the chance to reinvent their profession, redesign the disciplinary structure consisting of an obscure mix of myths, values, beliefs, rules, expectations of expectations, etc. If not it will disappear in insignificance.

The main obstacle to proceed from this diagnosis towards disciplinary action is, in my view, the not yet existing theory of *design as a social system* in an environment of other social systems. To be more concrete: the too simplistic and hardly reflected concept of system. To state that everything is somehow related to everything else is not an insight but rather the renunciation of every insight. If a systemic approach does not make explicit its theoretical basis and practical implications it will be not more than a moralistic appeal using the (at present) highly esteemed concepts of wholeness, integration, organism, etc. Re-*integration* is not the panacea as *differentiation*, having produced the problems we are facing, is also the essential condition of the efficiency of modern societies. We need explicit theories and derived methodic tools dealing with this *complementarity of integration and differentiation*. See JONAS (1997) for more details on complexity, contingency and on learning pathologies in design leading to the hypothesis that design is missing appropriate internal complexity to deal with growing external complexity (ASHBY´s law of requisite variety). A more elaborate approach is required both in theory (on the meta-level, in theoretical discourse) and in practice (on the operative level, regarding methodical tools).

Any „sustainable" theory or model of design must be able, self-referentially, to explain its own emergence and to deal with the inherent *temporality* and *context-dependency* of design as a social activity system. In several steps (JONAS 1994, 1997, 1998) the framework of such a theory has been worked out. Its epistemological basis lies in 2nd order cybernetics, introducing the concept of observing observations (VON FOERSTER 1979, 1981). The theoretical basis lies in sociological systems theory of the „Bielefeld school" (LUHMANN and WILLKE) and,

for the necessary links to methodology, in organization theory. In correspondence with GLANVILLE (1980) the nature of scientific knowledge and research is not taken as a paradigm for design but, conversely, as a design activity. Science, as well as art or technology, it is therefore argued, may not be used as the yardstick against which to measure design. GLANVILLE goes a big step further in claiming:

„If anything the converse is the case. And research into design should be considered as providing a paradigm for science."

Design is introduced, hypothetically, as autopoietic social sub-system **designing** (on the same level as science, art, economy, jurisdiction, etc.) as a flexible, context-sensitive, project-oriented (thus temporary) framework for new kinds of design tasks. **Designing** integrates engineers, designers, economists, social scientists, futurologists, etc. depending on the specific task. Problem-situations are conceived as systems too, i.e. design is taken as a process of *intervention* into (more or less autopoietic) systems (KRIPPENDORFF 1994, JONAS 1996c). Thus design, as an expert culture itself, acts as a communicative medium between expert cultures.

To come back to sociology: WILLKE (1989) sees as the main (slightly paradox) goal of sociological research the *re-integration* of society maintaining its high *complexity* and *differentiation.* In his view the permanent increase of internal complexity, necessary to secure the own evolutionary chances in the whole system, can be combined with a reduction of the scope of action. Therefore there is an increasing interest in integration. Three keywords illustrate his ideas:

(1) Reflection: Civilization of self-referentiality. Internal condition to enter an intersystemic discourse is the internal representation of the own unity as system in an environment (internally created outside-reference), requiring self-observation. Thus the system has the choice to organize itself as a more or less friendly or threatening environment of other systems and to check out alternatives. This can be denoted through the concept of empathy, the ability to observe events from the perspective of a different person or role. Design´s emphatic abilities are still mainly restricted to the designer´s personal ability to enter the role of the user. Design as a discipline is still mainly characterized by self-reference (e.g. via professional associations) as one of two necessary components of autonomy. This shows up in debates concerning disciplinary concepts. *Autonomy* is generated in the oscillation between *self-reference* and (internally created) *outside-reference.*

(2) Contextual intervention: civilization of power. Peculiar systems behaviour sets narrow limits to the exertion of directive power. Interventions can only be successful if they respect the autonomy of the system in question. Every external intervention has to rely on presenting itself as a relevant event in the range of possible perceptions of the other system in order to be smuggled into its operative cycles as an information. "Good" intentions of the intervening system do not ensure success. Self-reflection, thus systemic quality on both sides of the interaction, is necessary. Furthermore, "consensual areas" are required, i.e. shared communicative re-

pertoires which also comprise the *levels of intervention*. It should not be surprising that these conditions for communication and intervention are fundamentally different for individuals, groups, organizations, functional subsystems, and societies. Psychotherapy has different forms on the level of individuals and groups, and needs quite different forms of intervention as, e.g., organizational development. The same is true for organizations compared to functional subsystems as politics or economy. Nevertheless this is exactly the point where the great clash between "individual" and "systemic" thinkers occurs persistently (JONAS 1996 c).

Level	Communication	Form of Intervention
Interaction	direct	Intervention into patterns of interaction
Group	informal	mixed
Organization	formal	Intervention into patterns of expectations
Subsystem	medial	mixed
Society	intermedial	Intervention into patterns of intersystemic relations

Fig. 1: Levels of system formation and forms of intervention (WILLKE 1994: 53).

(3) Systemic discourses: guidelines for civilization of developed societies. As so-called "third instances" *negotiation systems* should be supported consisting of the relations of the actors involved: Only the combination of reflection ("complicate yourself"), contextual intervention ("improbability of successful communication"), and discourse create a mode of behaviour where the paradox of compatibility (not correspondence!) of diverging rationalities can unfold. The point is to support the abilities of de-centralized self-organization and to focus them towards the aim of civilization. Instead of adaptation and external correction, as propagated by traditional systems thinking we have to reflect the conditions of a controlled stimulus for autonomous systems to change themselves.

Systems can be analyzed in various dimensions, and the choice of perspective will depend on the nature of the problem at hand. The richer the descriptive tools the greater the variety of perspectives .Often the problem with which one starts quickly becomes part of a larger / different problem requiring a broader / different focus. This broadening (or deepening) / reframing of analysis adds to the complexity of the overall picture, but often brings benefits in identifying new ways of solving the problems of specific concern. JONAS (1997) starts to make explicit the various dimensions of the design process. Systems thinking as a highly formal approach is neutral as to those dimensions: (1) the contextual phases, (2) the steps of the process, (3) the

levels of reality, (4) the levels of the process, etc. Of course, any of these differentiations, aiming at increased internal complexity, needs further elaboration.

4 From first- to second-generation methods

The ideas presented suggest that designers (organizational members in general) acquire a new way of thinking about the systems of relations to which they belong, and that they understand how these relations are formed and transformed through processes that are mutually determining and determined. In understanding this kind of mutual causality, we recognize that it is not possible to exert unilateral control over any set of variables. *Interventions* are likely to reverberate throughout the whole. It is thus necessary to adjust interventions to achieve the kind of system transformations that one desires. This is not at all trivial (MORGAN 1986: 253):

"Though it is often possible to spot an initial "kick" that sets a system moving in a particular direction, it is important to realize that such kicks are not really the cause of the end result. They merely trigger transformations embedded in the logic of the system."

Obviously research in methodology has to be be re-vitalized. According to WILLKE (1994: 189): Linear development prolongs the present miseries into the future because it follows a "logic of failure" which is inevitable in the confrontation of simple models and complex realities. Systemic development, on the other hand, relies on the effort of adequate modelling and the ease of self-chosen paths of change. It notes that "normally" the solution is the problem and therefore takes an enervating lot of care over the reconstruction of the problem. Its solutions do not aim at the trivialization of the problem, but rather to appear by themselves after context and complexity of the problem have been clarified.

The "design methods movement" of the 1960s was strongly influenced by 1st order 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. See e.g. CHECKLAND (1993) for an overview. 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 (1984) characterizes this expert attitude:

"We are here to help the others: what the others are for I've no idea."

The efforts of the late 1960s and early 1970s to overcome 1st generation methods came to nothing. There was economic recovery and a sort of political roll-back that discredited the central idea of participation. And inside the discipline methods were rejected as functionalistic and mechanistic. There was lacking applicability indeed. The tools survived in engineering design and project management, far away from the creative process. Disillusionment was prevailing among leading methodologists: Christopher ALEXANDER (1971) replied the question as to important areas of future research in methodology:

"I would say forget it, forget the whole thing."

And John Christopher JONES (1974) 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."

Delay occurred in the discipline´s readiness to deal with new and still immature approaches. The "shifting-the-burden" mechanism took place (JONAS 1998), new stylish "light" theories were adopted to compensate for the deficits in meaning: Memphis, "Neues Deutsches Design", product semantics, etc. Later ecology-, interface-, network-design, etc. had similar functions.

JONES (1978: 136) stated the problem very clearly:

"The new design methods (brainstorming, system engineering, operational research, and many others) ... very easily become uncontrollable and confusing so that the designers get swamped in a mass of information, and a rigidity of procedure, that prevents common sense, intuition, and one´s own ability to think, from remaining in control. This is because they are presented as what they are not: panaceas, complete substitutes for thinking for oneself, for being responsible for what one is doing. The missing element is what I call ´designing designing´: the conscious direction of part of one´s activity and energy, while designing, into the meta-process of designing the process of design. At any point one should be aware of ´what you are doing´ and ´why´."

The designers of the 1980s postponed the newly upcoming problems and created pretty things and fetishes instead. They appeared as sort of egocentric artists, which in fact was also a step of liberation and emancipation from the burden of the unachievable aims and claims (to work for a better society) in the era of functionalism. This is still working, but there are more and more questions whether this should be all. We have to face the problems now, and that´s why there is a more promising situation as to "sustainable" methodology today. There is consent on the burning problems of managing complexity, on the dissent as to goals ("What is the problem?" is not self-evident any more and the question: "How do we want to live?" is neither trivial nor revolutionary any more.), on the crisis of expert cultures and their incompetence in dealing with ill-structured problems. And there is some more optimism even among the old methodologists.

JONES (1984: 224):

"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 unlearning, publicly, with changing, not fixed, self-images."

New systems thinking based on 2nd order cybernetics seems to provide promising tools, as applications in systemic therapy, management theory or organizational development are revealing (see e.g. ULRICH / PROBST, VESTER, SENGE, and many others). This does not mean the further elaboration of isolated tools, but rather the intelligent and flexible, more or less computer-supported, combination and integration of the various well-known components and existing knowledge on methods (e.g. JONES 1970). Today´s approaches are aiming at *discoursive tools* rather than closed algorithms. They structure the communicative process in de-

sign teams, between stakeholders in a design process, and between disciplines. To sum up the new methodic requirements, we need:

(1) System description and functional evaluation. The analysis of complex systems requires the basic elements, relations, and circularities the system consists of and the system is using to perform its self- reproduction to be distinguished and described. This does not depend on quantity and exactness of data.

(2) Intervention strategies. Interventions have to be formulated in terms of the system in question which contain the system´s identity. It is the system´s own mode of operation which decides on the success of interventions. I.e. the method should help to find out "critical" components and relations. It has to support simulation experiments of the type "what happens if ... ?" Intervention may occur as the *invention* of possible future states to be discussed in public argumentation.

(3) Openness and interactivity. 2nd order cybernetics is not a calculus but depends on user-orientation and openness of the process. It does not yield a forecast of events but rather insight into essential interdependencies within the system and - probably even more important - between the system and its observers (which are stakeholders in a planning process). Thus we come to a close connection of the design process and the design product where problem and solution evolve in parallel.

5 The scenario-process as a model for second order design

This attempt to develop theory and methodology, having in mind the experience of the 1970s, cannot work unless design is willing to permanently reflect its own acting and to widen its disciplinary conception: to take the function as *stakeholder in a network of future-shaping disciplines,* hypothetically called **designing**. LUHMANN (1973: 156) suggests: It seems reasonable to develop methods of complexity reduction where models of continuance serve as starting point and basis whereas purpose models are used when problems have gained more specific contours, i.e. complexity is already widely absorbed. A model of the "problem-solving" process is introduced: Transforming a "vague feeling of discontent" into a "solution" turns out to be a 3-step process of *reducing uncertainty (contingency).* The traditional design concept neglects the first two steps and acts at the very end of the process (JONAS 1996 a, b). The schema integrates the limited concept of *purpose* into the broader concept of *continuance.* Both are indispensible. 2nd order design, based on the model of continuance, acts as a non-trivial machine which is determined through its internal state, permanently shaping itself and its environment in a parallel process of co-evolution. 1st order design, based on the model of purpose, acts as a trivial I-O-machine which, from time to time, more or less voluntary, changes its internal transformation algorithm.

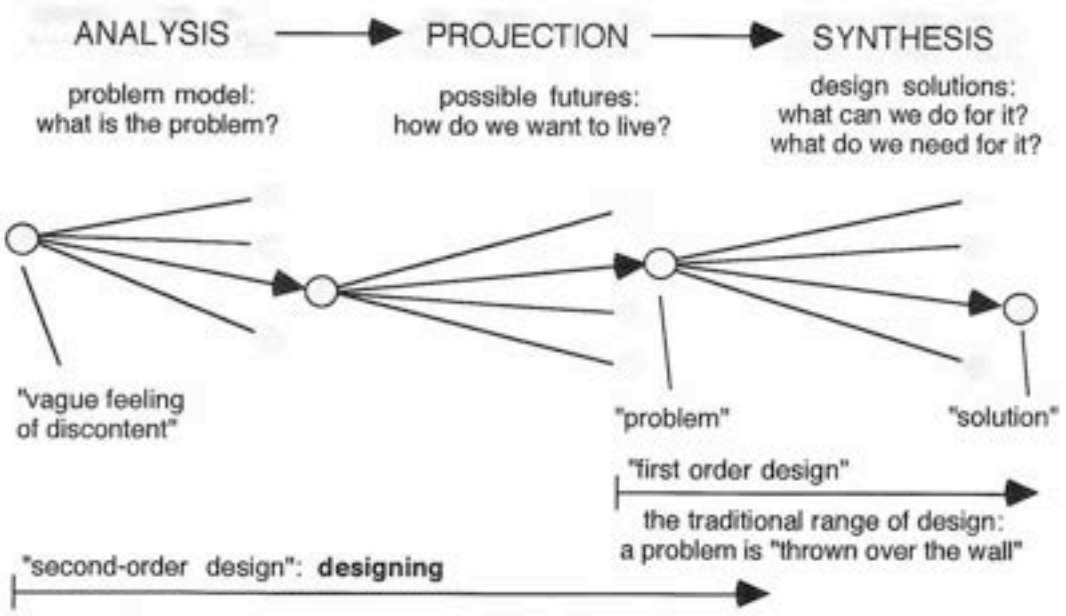

Fig. 2: Second-order design (**designing**) as a 3-step process of "problem-solving". Notice that the model is part of a bifurcation cascade!

Systems thinking as integrative instrumentarium is entering design mainly through the backdoor via organization theory. Therefore intense cooperation with management sciences seems necessary in order to keep the initiative. There are striking parallels between the extended concept of **designing** and the *scenario process* in management. VAN DER HEIJDEN, in his „art of strategic conversation", describes it as the implementation of organizational learning. In analogy I suggest to take the scenario process as the model of 2nd order design, i.e. design thinking for a broader context. Or, following GOLSBY-SMITH, as the „art of orchestrating conversations", or as negotiation systems (WILLKE). According to PORTER (1985), a scenario is:

„... an internally consistent view of what the future might turn out to be - not a forecast, but one possible future outcome."

Scenario planning is separated from more traditional methods of strategic planning through its explicit approach towards *ambiguity* and *uncertainty*. It turns *planning* from a once-off episodic activity into an *ongoing learning proposition*. Scenario planners intervene in this learning process aiming at broadening perception, thereby providing the requisite variety in mental models necessary to see and perceive the outside world beyond the traditional models. Scenarios provide a language through which the resulting issues can be discussed in the organisation, new theories of action can be jointly developed and shared, and alignment of mental models can be achieved, necessary for institutional action.

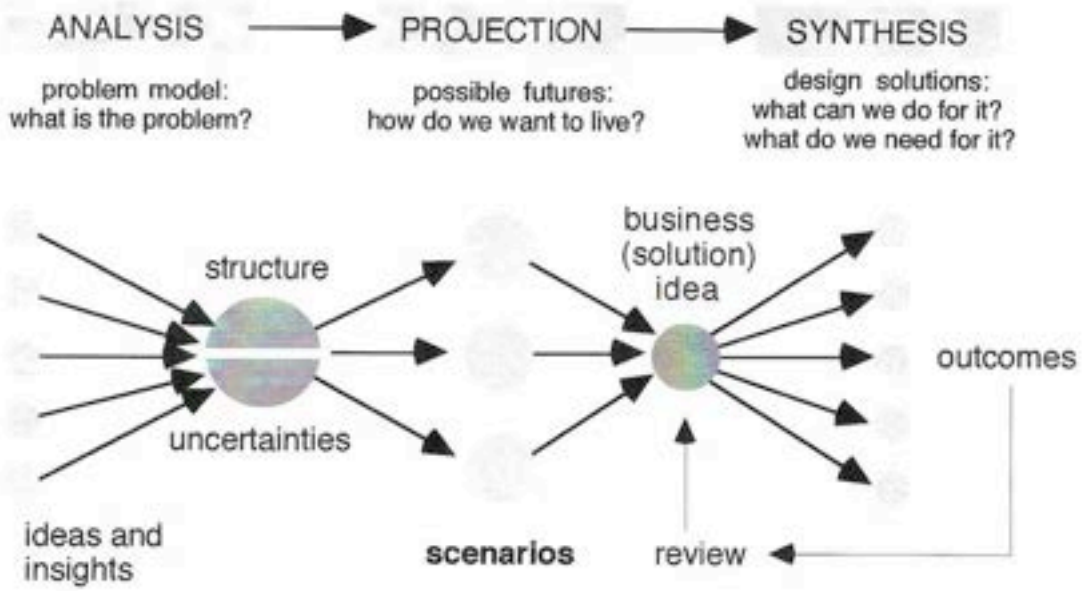

Fig. 3: The scenario process (VAN DER HEIJDEN 1996: 56) related to the 3 steps of the extended design process (figs. 7, 8, 9).

Stories are efficient vehicles for organising things in our mind, relating data across a wide range of subjects. Relating events causally, with one thing leading to another creates *meaning*. Also stories about the future (scenarios) are in a way historical accounts seen from a future perspective (backcasting). They explain how the world has ended up in a future end-state, by a causal train of events, linking back to the well-known present. They provide the designer with a flexible means to connect disparate data together into holistic pictures, providing the context and meaning of possible developments. The test of whether a system (team, organization, subsystem) has found a good structure for the scenario set and story lines is the degree to which these prove helpful in conceptualizing a previously unstructured area of concern, leading to new action that ultimately proves beneficial. This depends on finding appropriate points in the organizational system where an impact can be created (see sensitivity analysis).
Another important aspect is the concept of "early warning". If the scenarios have been done properly the system should have articulated a clear model of underlying structure to which the events in the scenarios are related. The same structure can be used to identify developments which could be the early signals of the world moving into the direction indicated by one of the scenarios. After the scenario project the system can identify such key variables and make these the subject of conscious periodic monitoring. By identifying such variables in the influence diagrams underpinning the scenarios the institutional attention can be moved in directions where structural differences become evident first.

To sum up: The scenario process / process of **designing** deals with the *system* (where the intervention / design effort, takes place, see ANALYSIS) and its future *context* (which has a - sometimes highly uncertain - impact on the system, see PROJECTION). These two concepts shall be considered in more detail now.

6 The system: What happens if ...? Sensitivity Analysis as a key concept

Peter SENGE states (1990: 72):

"Unfortunately, most "systems analyses" focus on detail complexity not dynamic complexity. Simulations with thousands of variables and complex arrays of details can actually distract us from seeing patterns and major interrelationships."

Systems thinking shows that small, well-focused actions can sometimes produce significant, enduring improvements, if they are in the right place. Tackling a difficult problem is often a matter of seeing where the high leverage lies, a change which - with a minimum of effort - would lead to lasting, significant improvement. The problem is that high-leverage changes are usually highly nonobvious to most participants in the system. They are not "close in time and space" to obvious problem symptoms. There are no simple rules for finding those variables or relations that are of critical importance for the system, but there are ways of thinking that make it more likely. Learning to see underlying structures rather than events is a starting point. Thinking in terms of processes of change rather than "snapshots" is another. Regarding levels of reality see JONAS (1997).

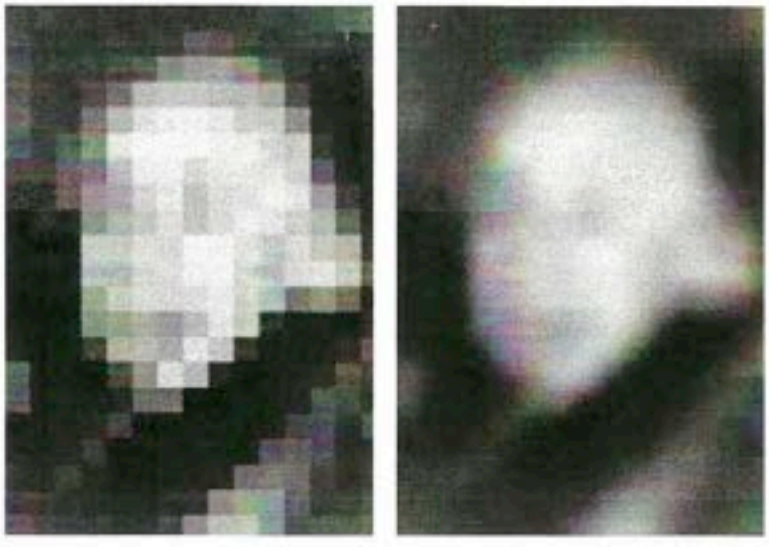

Fig. 4: A metaphoric illustration of the idea that it does not make sense to investigate the system in detail but rather to have a fuzzy but complete view of the system.

A key concept of practical systems thinking is *Sensitivity Analysis* (SIMON 1978, VESTER 1993) based on appropriate *problem models* as representations of real-world problems. The aim

is to handle the system´s complexity not in the reductionist way traditional science is used to, i.e. by isolating those variables that are observable and measurable but through reducing the system to a *representative* set of (qualitative and quantitative) variables and relations that is necessary to describe it as concisely as possible without destroying its systemic character. Fig. 4 illustrates this concept. Sensitivity modelling covers mainly step 1 (ANALYSIS) of the above mentioned 3-step model of the design process. Additionally, through serving as a problem language, it acts as a catalyst for the creation of shared visions / narrative scenarios in step 2 (PROJECTION). The components were existing 20-30 years ago. What is new is the way of using the method as a discoursive rather than mechanistic tool.

Based on a set of variables set up in an interdisciplinary group it is possible to negotiate the potential impact of each variable on each other. The well-known method of *cross-impact analysis* looks rather mechanistic but in fact it is a means to guide discussions in a team of stakeholders and to present the outcome in a condensed form. Fig. 5 is automatically derived from a cross-impact matrix and shows the *systemic role* of every variable (active, reactive, critical, buffering, or neutral), thus giving important hints as to their sensitivity with regard to interventions. The figure illustrates one step out of a methodic toolbox which covers the ANALYSIS phase and is useful as a basis for PROJECTION (VESTER 1993). The tools can be regarded as elements of the systemic language systems thinking is striving at.

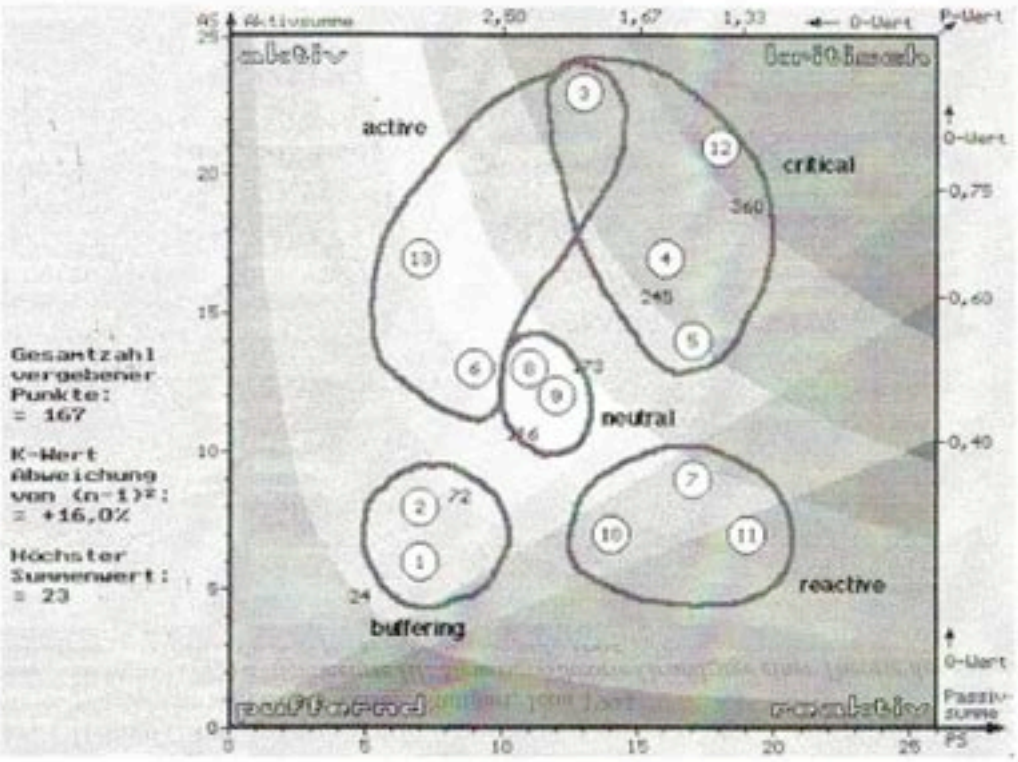

Fig. 5: Sensitivity map: roles of variables derived from cross-impact analysis.

The outcome can be used for further "rationalistic" steps, e.g. building feedback-networks as a basis for quantitative simulations (see e.g. the system dynamics approach). But it can also be used to bridge the gap between ANALYSIS and the more narrative PROJECTION step in the design process. The active variables are the main actors in the scenarios, the *critical* variables in the upper right quadrant are those to be handled with special care, as they with *high impact* on others and, at the same time, *high uncertainty* as to their own future behaviour in the system.

7 The context: there are many futures

The following example illustrates the use of contextual scenarios in order to develop future contexts for present problem situations (e.g. internet-presence of a youth radio, the future of the the healthcare-system). Starting point is a complex, obscure situation which, apparently, cannot be influenced. A typical „German" perception, based on mainly implicit „myths of the past" (the "word of the year 1997" in Germany is: Reformstau, i.e. reform jam). This reactive perceptiopn is not very useful to think about change and opportunities. Scenarios, in contrast, are realistic fairy tales, myths of the future, making explicit all assumptions used. Thus scenarios are inherently generative.

Im Prinzip ohne Hoffnung

Fig. 6: A myth of the past: „In principle without hope". Headline, DIE ZEIT, 18 July 1997. The luxury liner „Globalization Tours" leaves the „Welfare State" in overcrowded lifeboats.

One approach to scenario building is to select two *contextual variables* with *high impact* on the system and - at the same time - *high uncertainty* as to their future development (here, too, cross-impact analysis may be helpful). These are then used to define a field of possible future states (WILKINSON, SCHWARTZ). E.g. the variables could be social isolation versus social cohe-

sion (new communities) in the first dimension and stagnation versus innovation in the second dimension. This creates 4 characteristic combinations defining 4 scenario frames. Fleshing out these should be done in an interdisciplinary team using strong metaphors (here maritime images). The aim is to create consistent narratives describing 4 extreme future contexts which then serve as *testbeds* for design decisions. The diffuse initial image will thus be differentiated into four very clear possibilities. In the example we are e.g. in the year 2005.

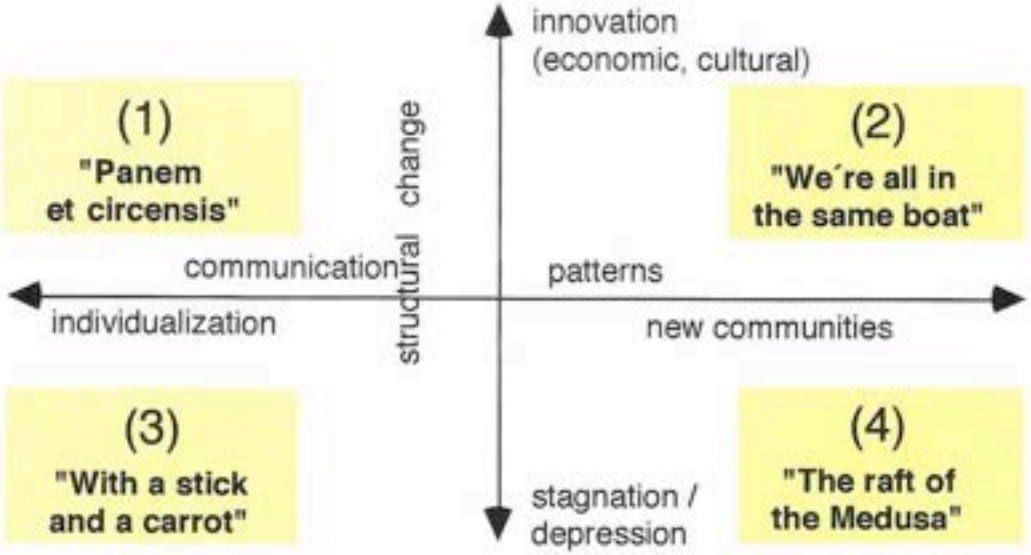

Fig. 7: Scenario matrix ("quattro stagioni")

(1) „Panem et circensis"
The post-industrial "2/3 society" has been established now. There are severe social differences, because the high unemployment rate is decreasing only slowly. Basic tendencies are egoism and individualization. The growing prosperity through the new high-tech industries has made possible a basic social security system, however, which prevents the worst.
There are various services offered for those who are not working (entertainment, education, information). Many people criticize that as a strategy of "panem et circensis". Ambitious young people who benefit from the various educational offers have realistic chances to make a career for themselves. This is supported by the fact that years with low birth rates are entering the professional life. Nevertheless many people who are not able or not willing to adapt to the rapid change of values drop out of the social networks.
The state moves back from many areas, after the worst phase of the crisis from the end of the 1990s seems to be overcome now.

(2) „We´re all in the same boat"
The post-industrial service society has become reality and the process of structural change seems to work now. Material intensity of the production is decreasing permanently. Ecology and economy are not in conflict any more. The change of social values is everyday reality. It is combined with a surprising tendency towards new communities of various kinds. These relations and networks provide social orientation in complex environments.
Work is increasingly judged with respect to its social relevance. Though the "unemployment" rate (still the official term) is still relatively high the negative side-effects as general depression and anxiety are vanishing. The individual self-esteem is no longer depending on the possession of one of those formerly fetishized "jobs". Engagement and responsibility are more important today.

Governmental structures are changing. De-centralization is a major trend. It is combined with the various forms of direct democracy emerging from the grass-roots.

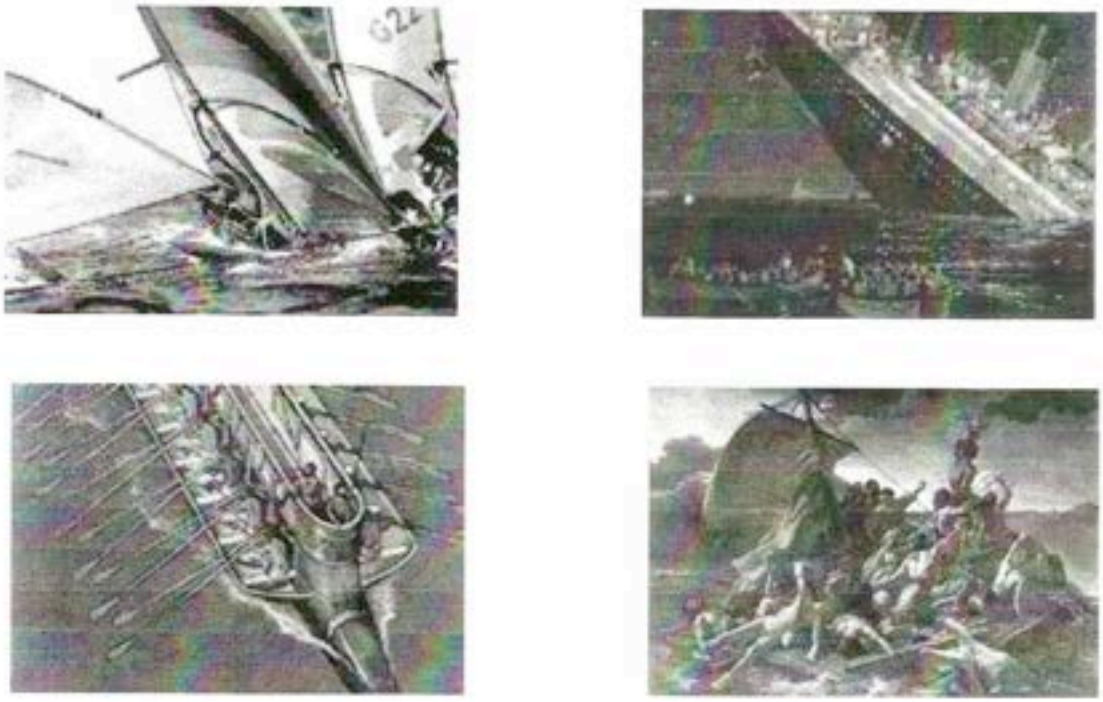

Fig. 8: Metaphorical images for the 4 scenarios.

(3) "With a stick and a carrot"
The late-industrial crisis has come now; in a severity which was inconceivable only some years ago. The slow speed of innovation, the hesitation and missing leadership of the politicians, and the anxiety of the people have caused a rapid deterioration of the social climate. There are extreme social differences which lead to frequent riots because of the general state of social coldness. Ghettoes are rapidly spreading in the big cities.
Chances for young people - who are more and more becoming an excluded minority - to get a job, are minimal. In the so-called "pension debate" of the years 1996-1999 the older ones were successful in claiming the main share of the shrinking "cake" for themselves.
On looking more carefully there are first, still inconspicious signs of cyber-fascistic power structures. The authorities are trying to use the still existing public communication networks for the observation anbd control of the growing potentials of violence.

(4) "The raft of the Medusa"
The effects of the late-industrial crisis have stroken, structural change has not taken place. Politicians had not the quality and persuasiveness to consequently realize the reform projects which they had propagated and, in part, even initialized. The process got stuck halfway through. It left numerous reform ruins as e.g. the Ruhr coal-mines which are still working, with reduced security standards and still with high subventions. The people were not willing to get involved in uncertain future pespectives. Protection of the existing and mental lethargy were dominant. The standard of living of most people has dropped dramatically.
Nonetheless the state is not fallen into chaos, because, surprisingly, a strong social coherence has emerged in the crisis. Starting in the "new states" the old-fashioned concept of "solidarity" has seen a strong revival. What the welfare state, which is still working on a minimum level, cannot provide anymore is taken over by the new networks on neighbourhood- and local levels. Despite great social differences tensions are tolerable, because the rich people see it as their duty to support the poor on a voluntary basis.

Government politics has been reduced to core areas; people are expected to act self-responsible and on their own initiative (at least here the structural change was successful).

By working with different contexts, various explicit futures we get free from the anxious attitude of *reacting* (because of the uncertainty of the *one* future). Instaed we achieve a *generative* attitude of acting in uncertainty, explicitly knowing a *variety* of futures in full detail. Questions arising from that are: What shall we do to be prepared to all possible futures? or: What can we do to make one of the preferred alternatives come true?

8 Conclusions and perspectives: Design as Futures Studies

We had 1st generation design methods and we had the critique of these methods. We have the development of 2nd order cybernetics and sociologic theory. In order to keep up we should continue to develop *2nd generation methods for 2nd order design*. The aim cannot be the elimination of differentiated social systems. Romanticizing incantations of paradise gardens and appeals to ethics (see e.g. MANZINI) are fruitless. New ethics, already ARISTOTLE knew that, arise from practice, not vice versa, new practice from the propagation of new ethics (JONAS 1995). We need *negotiation systems* on all levels of society aiming at the civilization of functional differentiation. *Design thinking*, as described by BUCHANAN, can play an important role in this context. In order to gain *definition power* regarding future ways of living, the discipline can rely on its *inventive* capabilities. Based on systemic constructs for theory-building (own system) and methodic tools (other systems) it has to develop *integrative* (discoursive) and *generative* (projective) capabilities. This might result in a slowing but also broadening of the development so that the speed of technological evolution is lower than that of cultural evolution. Thus we „increase the variety of choices" (VON FOERSTER).

This ambitious project of **designing designing** needs a strong commitment towards *continuous* theory and methods development in order to build a shared and growing body of knowledge and tools. Even worse: rebuilding the discipliniary "boat" has to be done "on the high seas". Conceiving the discipline as a learning social system (JONAS 1998) leads to the concept of designing as a pragmatic part of Futures Studies (MASINI). The promising reward for this effort could be increased *viability*.

9 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* 1 (1) 1979 pp 17 - 18

Ashby, William Ross *Einführung in die Kybernetik* Suhrkamp-Verlag, FrankfurtM. 1974 Original: *An Introduction to Cybernetics* 1956, 1964

Buchanan, Richard (1990) „Myth and Maturity: Toward a New Order in the Decade of Design" in: *Design Issues* Vol. 6, No. 2 (Spring 1990) pp 70-80
- (1992) „Wicked Problems in Design Thinking" in: *Design Issues* Vol. 8, No. 2, (Spring 1992): 5-21
- (1994) „Branzi´s Dilemma: Design in Contemporary Culture" in: Tahkokallio, Vihma (eds.) *Design- Pleasure or Responsibility?* Helsinki 21-23 June 1994 pp 10-29
Checkland, Peter *Systems Thinking, Systems Practice* John Wiley & Sons, Chichester 1993
von Foerster, Heinz *Observing Systems* Seaside, Cal. 1981
Glanville, Ranulph "Why Design Research?" In: Jacques, R.; Powell, A., *Design: Science: Method* Westbury House, Guildford 1980
Golsby-Smith, Tony „Fourth Order Design: A Practical Perspective" in: *Design Issues* Vol. 12, No. 1 (Spring 1996) pp 5-25
van der Heijden, Kees *Scenarios: The Art of Strategic Conversation* John Wiley & Sons, Chichester 1996
Jonas, Wolfgang (1994) *Design - System - Theorie. Überlegungen zu einem systemtheoretischen Modell von Designtheorie* Verlag Die Blaue Eule, Essen 1994
- (1995) „Design und Ethik - brauchen wir eine Sondermoral für das Design?" 15. designwiss. Kolloquium *Design und Ethik*, Hochschule für Kunst und Design Halle, 1995
- (1996a) "Systems Thinking in Industrial Design" System Dynamics '96, Cambridge, Mass. July 1996
- (1996b) "No Guru - Many Methods. Towards New Ways of Systems Thinking in Design" *No Guru - No Method?* International Conference on Art and Design Research, 4-6 Sept. 1996, University of Art and Design Helsinki UIAH, Finland
- (1997) „Viable Structures and Generative Tools - an approach towards "designing designing"" *contextual design - design in contexts* the european academy of design, Stockholm 23, 24 and 25 April 1997
- (1998) "Design as Social System. Reflections on a systems theoretical foundation of design theory" submitted to *Design Issues*
Jones, John Christopher (1970) *Design Methods. Seeds of human futures* John Wiley&Sons, London 1970
- (1974) "How My Thoughts about Design Methods have Changed During the Years" in: *Essays in Design* John Wiley&Sons, Chichester1984 (Original 1974)
- (1978) "designing designing" in:*Essays in Design* John Wiley&Sons, Chichester 1984 (Original 1978)
- (1984) "Softecnica" in: *Essays in Design* John Wiley 1984
Krippendorff, Klaus (1994) „Redesigning Design. An Invitation to a Responsible Future" in: Tahkokallio, Vihma (eds.) *Design - Pleasure or Responsibility?* Helsinki 21-23 June 1994 pp 138-162
Luhmann, Niklas (1995) *Social Systems* Stanford University Press, Stanford, California 1995
Original: *Soziale Systeme. Grundriß einer allgemeinen Theorie* Suhrkamp, Frankfurt / M. 1984
Manzini Ezio „Prometheus of the Everyday. The Ecology of the Artificial and the Designer´s Responsibility" in: Buchanan, Margolin, eds. *Discovering Design* The University of Chicago Press, 1995 pp 219-243
Margolin, Victor (1996a) „Global Expansion or Global equilibrium? Design and the World Situation" in *Design Issues* Vol. 12, No. 2 (Summer 1996)
- (1996b) „Design Research and Design Studies: Why We Need Both" A lecture given at the conference *"No Guru, No Method?"* UIAH Helsinki, September 6, 1966
Masini, Eleonora Barbieri *Why Futures Studies?* Grey Seal, London 1993
Maturana, Humberto R.; Varela, Francisco J. *Autopoiesis and Cognition: The Realization of the Living* Reidl, London 1980
Morgan, Gareth (1986) *Images of Organization* Sage Publications, Newbury Park, London, New Delhi 1986
Porter, Michael *Competitive Advantage* Free Press, New York 1985
Prigogine, Ilya *Order out of Chaos* Random House, New York 1984
Rittel, Horst W.J. "Second-generation Design Methods" in Cross (ed.) *Developments in Design Methodology* John Wiley, Chichester1984 pp 317-327 (originally published 1972)
Ropohl, Günter (1979) *Eine Systemtheorie der Technik. Zur Grundlegung der Allgemeinen Technologie* Hanser, München 1979
Schwartz, Peter *The Art of the Long View* Currency Doubleday, New York 1991
Senge , Peter *The Fifth Discipline. The Art & Practice of the Learning Organization* Currency Doubleday, New York 1990
Simon, Herbert A. "Simulation of Large.Scale Systems by Aggregation" in: *Sociocybernetics* Vol. 2, ed. by F. Geyer and J. Zouwen, Leiden u.a. 1978 pp 113-122
Ulrich, Hans; Probst, Gilbert J.B. *Anleitung zum ganzheitlichen Denken und Handeln* Paul Haupt, Bern und Stuttgart, 3. Aufl. 1991
Vester, Frederic *Sensitivitätsmodell, SM-Methodenhandbuch* Studiengruppe für Biologie und Umwelt GmbH, München 1993
Wilkinson, Lawrence "How to Build Scenarios" in: *Wired* 1995

Willke, Helmut (1989) *Systemtheorie entwickelter Gesellschaften. Dynamik und Riskanz moderner gesellschaftlicher Selbstorganisation*. Juventa Verlag, Weinheim und München 1989
Willke, Helmut (1993)*Systemtheorie. Eine Einführung in die Grundprobleme der Theorie sozialer Systeme* Gustav Fischer Verlag, Stuttgart, Jena, 4. überarbeitete Aufl. 1993
Willke, Helmut (1994) *Systemtheorie II: Interventionstheorie. Grundzüge einer Theorie der Intervention in komplexe Systeme* Gustav Fischer Verlag, Stuttgart, Jena 1994
Willke, Helmut (1995) *Systemtheorie III: Steuerungstheorie Grundzüge einer Theorie der Steuerung komplexer Sozialsysteme* Gustav Fischer Verlag, Stuttgart, Jena 1995

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