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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

Abstract
It is observable that cultural evolution (not progress) is combined with increasing complexity. This complexity on the "problem" side (what is the problem?) leads to contingency on the "solution" side (how do we want to live?). The induced process of change can be expected to accelerate.
The design discipline is used to react to changing contexts. Beneath this short-term adaptation on the surface, however, it is fixed in static structures that one side is protecting as "eternal" truths while others want to tear them down completely, proclaiming e.g. the "death of the designer". That´s why the story of design is accompanied by severe crises in self conception and almost no progress (in a scientific sense).
As a primary requirement in order not only to adapt and react to contexts but to act in contexts, to intervene into contexts, to create and generate contexts it is necessary to reshape and broaden the concept of the discipline. If design wants to become a respected partner in the emerging network of future shaping disciplines it has to work out a theory-based set of advanced methodic tools .
Based upon a descriptive systems-theoretic framework the outline of a flexible methodic approach is presented that
- broadens the concept of the design process by including very early phases,
- covers all levels of designing from the creative process to corporate planning,
- integrates design process and design results in a recursive schema,
- is using systems thinking as the integrating meta-discipline,
- promotes a common terminology (systemic language) for interdisciplinary work,
- thus supports a generative rather than reactive design attitude.
*The focus is to establish links from the traditional field of design to management, planning, marketing, etc. and thus to develop the methodical and educational competence to cooperate in new and broader contexts. The concept of **designing** is presented as a flexible, temporary, project-oriented network of future-shaping disciplines.*

The approach is "research for design" as opposed to "research about design" (MARGOLIN). Nevertheless it aims at contributing to a shared knowledge base for both parts of the (hopefully) evolving design discipline.

Keywords:
design, context, systems thinking, methods, management, education.

1 Delayed Reactions - the situation in design

It sounds like a commonplace, but is nevertheless true: We have an accelerated increase of complexity; sometimes reality appears even chaotic. There is *complexity* on the "problem" side: how we perceive reality, and there is *contingency* on the "solution" side: how we may react / act / design in this reality. Life itself has become a design problem.

So-called *bifurcation cascades*, known in the mathematics of chaos to investigate transitions from order to chaos, can be used metaphorically to illustrate our incapabilty of any kind of forecasting / prognosis of future states through simple extrapolation of observable trends (that´s why seen from today we should speak of "possible futures" instead of one single future). And they can be used to explain the method of "backcasting" used in planning theory to determine the steps leading to a desired future state.

Fig.1 shows the explosion of technologies and services and (designed) products in the field of telecommunication which exactly reveals the pattern of a bifurcation cascade. This observation is similarly valid in many other fields.

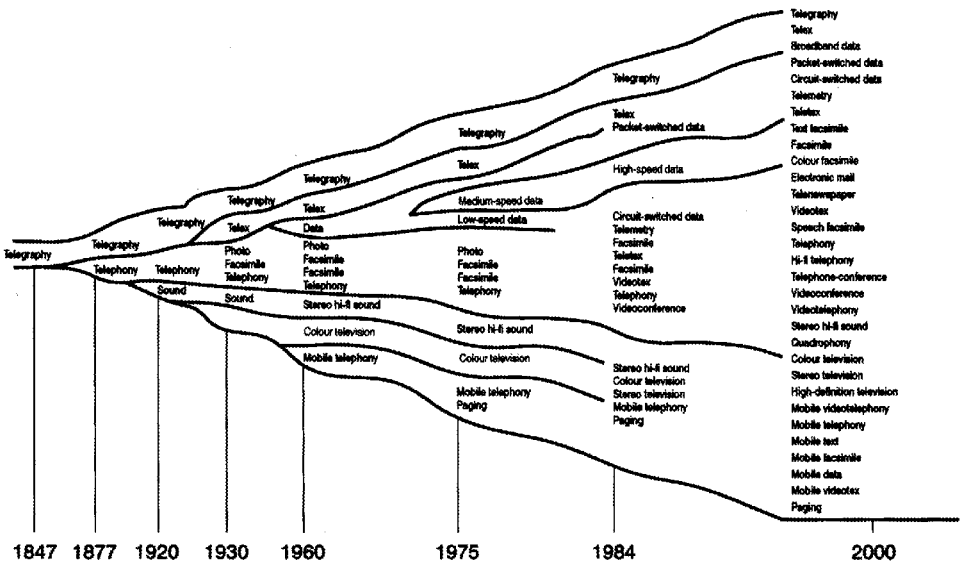

Fig. 1: The expanding range of telecommunication services (GRAHAM / MARVIN 1996: 16) shows the pattern of bifurcation cascades.

Designers are acting at the right end of the cascade (at the outer tips of the tree, in "*real-time*"), where the final products and services are shaped; they are not involved in the projection of future states (represented by larger branches of the tree, requiring *projection*). Although also services are industrially planned and produced today, design is still mainly occupied with products and their surfaces. Some call it interfaces and pretend this to be a promising new concept for the whole of design (BONSIEPE).
Material products, especially in the field of information, communication, entertainment, and knowledge processing, become more and more secondary; *transient materializations* in the patterns of behaviour and use of technologies that are dominated by software. Take e.g. the laptop computer: When it can no longer connect me to the electronic information environment as effectively as some competing product (even though it still works perfectly well), I shall simply transfer my software and data and throw the superseded case away. The market ecosystem is a ferociously Darwinian place that produces endless mutations and quickly weeds out those no longer able to compete. As MITCHELL (1995: 5) states:
"Neither handicraft of the sort so passionately defended by Ruskin and Morris, nor durable, standardized, mass-produced, industrial object of the kind that fascinated the early modernists, my laptop is an emblematic product of the electronic information age."

It can be expected that the share of this type of objects belonging to the "exploding" branches of the bifurcation cascades will grow. And even worse: It can be foreseen that the styling of those frequently changing cases will be increasingly automated and conducted under the control of engineering people. COOPER / PRESS (1995: 18, 43) call this "silent design". Intelligent CAD-modellers will support functions like: "Shape this surface & edges in Memphis / Finnish functionalist / etc. style". Maybe designers will be still helpful in the development of the styling algorithms. As to possible approaches towards the automatization of designing in its traditional sense of giving shape to material objects see e.g. NADIN.

What then could be new fields for designers? The crucial design tasks of the future (certainly not to be done by designers alone) seem to be those of *imagining*, *inventing*, and *creating* real and digitally mediated *contexts* and environments for the kinds of lives that we will want to lead and the sorts of communities that we will want to have. MITCHELL (1995:5):

"Massive and unstoppable changes are under way, but we are not passive subjects powerless to shape our fates. If we understand what is happening, and if we can conceive and explore alternative futures, we can find opportunities to intervene, sometimes to resist, to organize, to legislate, to plan, and to design."

Is the design profession prepared for these perspectives? Is the discipline willing to learn: to question and reconsider its core competences? In a way that enables not only to react but to take part, to generate, to contribute. I fear it is not! My hypothesis is that its *internal complexity* of discourse is unsufficient to deal with increasing *external complexity*.

2 Vicious Feedback - two systemic narratives

The following diagrams are telling a "story" which is expanded in the text, illustrating the situation (in my assessment) and showing the direction of the further argument, already using some of the proposed terminology and tools.

Frequent crises in disciplinary self-concepts lead to the adoption of *stylish design theories / ideologies* which, in turn, are able to release the crisis for a while through furnishing *meaning* and theoretical foundation for the discipli-

nary practice. For a description and suggested explanation of this "algorithm of innovation cycles" in theory building see JONAS (1994: 50-68).
On the other hand there are *long-term activities* of theory-building that serve the same purpose, but have considerable *delays* before showing any effect in everyday practice. The last great effort in long-term theory-design took place in the sixties and ended in the early seventies. There were hardly any immediate effects, if at all they were even negative, driving researchers like Christopher ALEXANDER or John Christopher JONES to retreat from the field. But nonetheless there are long-term influences; *this paper being one of them*.
Becoming familiar with working on the basis of those short-term theories / ideologies has the fatal side-effect that fundamental, future-oriented, generative theory work is widely neglected. The abilities and infrastructures to do this autonomously, inside the discipline, become stunted or even disappear. Unlike e.g. medicine - another academic discipline aiming at purposeful action in practice - the necessity of continuous theory work is hardly acknowledged in design. This is a *vicious circle* having driven design into the poor role of an *auxiliary discipline* of economy, marketing or whatever. Theory (mostly *about* design) is left to those reflecting disciplines as philosophy, cultural sciences, etc. which do not care very much about design´s fitness for its crucial everyday function of shaping our ways of living. Fig. 2. illustrates this argument in a concise systemic "language".

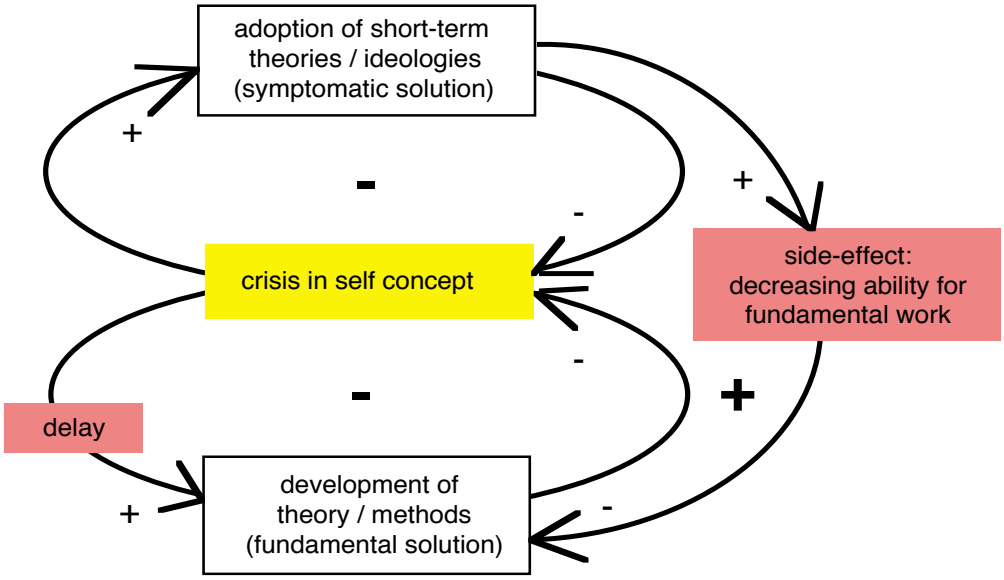

Fig. 2: "Shifting-the-burden" from fundamental to symptomatic solutions.

How to face this precarious situation? The modest and comfortable self-concept of design as an indispensable but nevertheless auxiliary discipline (thus *not responsible* for its contributions to culture) will not promote the development of a theoretical base and an appropriate methodology. The *decline* will be disguised for a while through the adoption of fashionable new catchwords as Interface-Design, Multimedia-Design, Network-Design, etc., and through its still high economic importance.

If design wants to consolidate its academic status with a respected theoretic basis it will be forced to broaden and expand its self-assessment towards *claiming* an appropriate share in the *definition power* as to our future conditions of living. A larger claim and a clearer conception of the own role will trigger theory-building, that sounds rather easy. A *virtuous circle* is showing up (fig. 3 on the left).

But there are those *limiting conditions* deriving from the problems mentioned above (shifting-the-burden, fig. 2.). Generative theory is neglected in most academic institutions resulting in growing deficits. There are internal conflicts as to the necessity of theory at all and external problems as to the capability of interdisciplinary work. All this is slowing down the development of new concepts.

And there are of course those "real" limits deriving from other disciplines´ claims (architecture, engineering, urban planning, futures research, etc.) and from the difficulties of theory building in general. No theory is irrefutable. But those limits are far away, there is a lot to be done before they will be reached and a critical discourse with those neighbour disciplines is possible. Fig. 3. tries to illustrate this story.

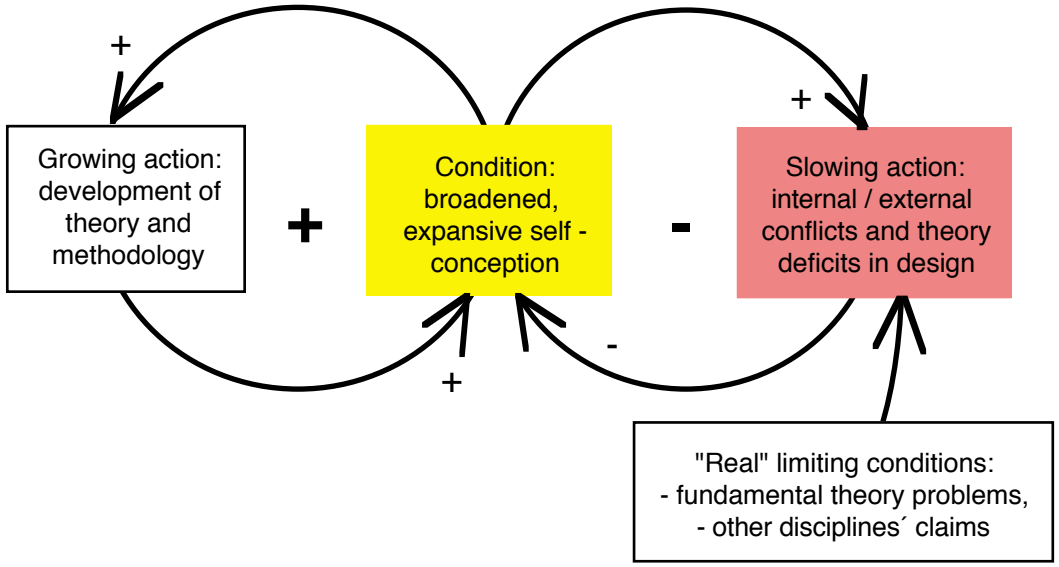

Fig. 3: Self-induced "limits of growth" in design theory / methods / practice.

There are many possible (contingent) ways to intervene. One could move on systemically to determine the most promising leverage (point of intervention). This would be a large empirical project of its own being research *about* design, though at last probably leading to benefits *for* design. Instead I will continue ("half-empirically") working out my approach in more detail. Finally *sensitivity analysis* as is introduced as a method *for* design to find out points of intervention into problem fields . Of course this method could be self-referentially applied to design itself in order to "designing designing" (JONES 1978) or to "redesign design" (KRIPPENDORFF 1994) as mentioned above.

3 Continuous Change -

the contextual perspective

Any theory or model of design must be able to explain its own emergence / creation. *Self-reference* is necessary. And any theory and derived method must be able to deal with the inherent *temporality* and *context-dependency* of design as a social activity system in a larger social system. A theory unable to do so, is too narrow and short-termed (as product-semantics, functionalism, etc. when taken as a complete theory). I.e. a "sustainable" design theory has to be built on a *meta-level*, comprising all these necessary theory "fashions". See JONAS (1994). The following half-empirical schema (figs. 4a, b) serves as starting point and framework for the methodical considerations.

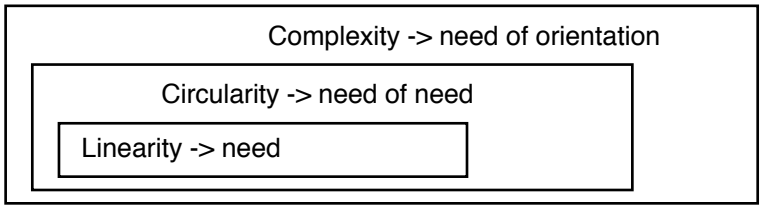

Fig. 4a: 3 phases of changing design contexts.

The suggested *3-phase schema of design contexts* has several dimensions: needs, CI, the function of design, the concept of problem, method, theory, etc. Regarding, e.g., the relation of need:

- we had a situation of *linearity* (need), with products convincingly pretending to solve problems,
- we had (still have) a situation of *circularity* (need of need), with products promising to solve problems, to give status, meaning, happiness, etc. and - even more important - serving as catalysts in the accelerating production-consumption-cycle,
- and we are facing a situation of *complexity* (need of orientation), with contexts and environments that make sense or do not. Due to their proliferation, *products become more and more secondary*.

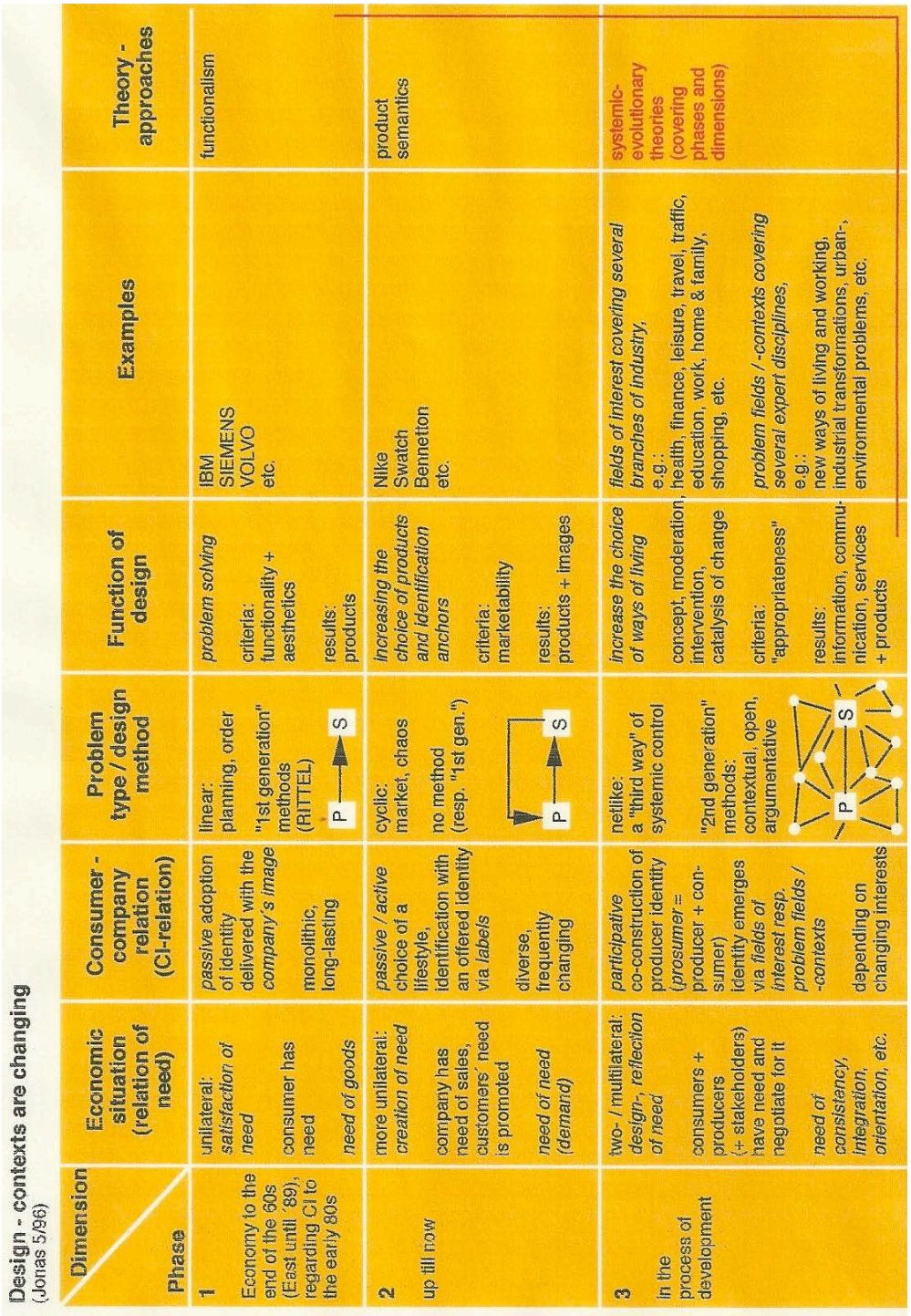

Fig. 4b: 3 phases of changing design contexts, expanded.

In pluralistic social planning processes there is no longer the dominance of one discipline (science, economy, politics, etc.); there is a *network of disciplines* instead. Decision-making is a process of negotiation. Regarding economy there is a strong feedback of consumers, thus becoming "pro-sumers" (producers + consumers). These networks may even develop into independent (virtual / real) communities, bound together through similar interests / needs / aims / ...

Recognizing and accepting *change* as an essential element of theory and methodology has nothing to do with uncritical adaptation to contexts, e.g. optimal adaptation to economy. Thus efforts to defend design´s "eternal values" as reaction against a shift of emphasis from design as "the art of problem solving" to design as "stylistic diversity to raise sales" raised valid questions about both the quality of much design work and the interests that it served. However, in focusing upon the negative developments in consumer culture, critics neglect the positive aspects of change, e.g. the deconstruction of the myth of "problem solving" or the deconstruction of "phantoms" (TAKALA-SCHREIB 1996) such as "functionalism" or "gute Form".
COOPER / PRESS, state that (1995: 45):
"The scope, methods and objectives of design are not fixed. They change over time and vary according to economic and cultural context. But this is not to say that design is passively determined by economy and culture. It is a social activity, the practitioners and users of which play a part in determining its direction. ..."
Social activity, if determined through its own structure and thus clearly distinguishable from its environment can be treated as "social system" (LUHMANN). The central question is: How is a non-trivial system (as design) able to constitute and reconstruct itself in a highly complex, chaotic environment? This is not primarily a question of static structure or of optimal adaptation but a question as to the conditions of the possibility ("Bedingungen der Möglichkeit") of organized complexity. The hypothesis is: *viability is constituted through appropriate internal complexity*.

To sum up: Contexts are permanently changing, the *constructedness* and *context-dependency* of problems increases. That´s why traditional methods reveal deficits as they tend to consider problems as "real", fixed, and static,

as somehow "thrown over the wall". In consequence they consider solutions as final, according to some "eternal" criteria.

4 Appropriate Complexity - the systemic approach

Systems thinking is adopted as theoretical and methodical basis. See e.g. CHURCHMAN, CHECKLAND, LUHMANN, WILLKE. One of the main origins lies in cybernetics. There is *1st order cybernetics* (WIENER et al.), dealing with observing an objective reality: the problem of control. E.g. bringing a man to the moon is a typical 1st order problem. And there is *2nd order cybernetics* (VON FOERSTER et al.), dealing with observing observations, thus *constructing* a reality: the problem of negotiation and argumentation. Those new problems of planning and design in *ill-structured* situations cannot be "solved" once and for all but they *evolve* in a more or less convenient way, stimulated by interventions.

The "design methods movement" of the 60s was strongly influenced by cybernetic thinking (1st order at the beginning) 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 CHECKLAND (1993: Chapter 5) 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 (1988) characterizes this narrow-minded expert attitude:

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

Horst RITTEL (1972) states that

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

The efforts of the late 60s and early 70s to overcome the mechanistic 1st generation methods (see JONES 1970, RITTEL 1972, et. al.) came to nothing. There was economic recovery and a sort of political roll-back that discredited the central idea of participation. And inside the design discipline methods were rejected as functionalistic and mechanistic. There was lacking operationalization indeed. The tools resembled the old 1st order cybernetics

tools; they survived in engineering design and project management, far away from the creative process.

In the early 70s there was great disillusionment 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. Thus the "shifting-the-burden" mechanism took place (fig. 2), new stylish "light" theories were adopted instead to compensate the disciplinary deficits in meaning: Memphis, "Neues Deutsches Design", "Theorie der Produktsprache", 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) are not easy to use. They 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 80s abandoned any rationalistic ways of problem-solving. They postponed the newly upcoming problems and created pretty things and fetishes instead. They presented themselves as sort of egocentric artists, which in fact was also a step of liberation and emancipation from the burden of the great but unachievable aims and claims (to work for a better society) in the era of functionalism. This dynamics is still working. Design is a factor of considerable importance in the production-consumption cycle, but there are more and more questions whether this should be all. We have to face the problems (first addressed in the early 70s) 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 (1988: 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, et.al.). This means not so much the further development of ever more elaborate isolated tools, but rather the intelligent and flexible combination, integration and application of the large amount of well-known components and existing knowledge on methods (see e.g. JONES 1970). Today´s approaches are aiming at *discoursive tools* rather than closed algorithms structuring the communicative process in design teams, between disciplines and between stakeholders in a design process.

5 Viable Structures - broadening the disciplinary concept

This second attempt to develop methodology after the 70s can work only if design is ready to permanently reflect its own acting and if it is willing to wi-

den its disciplinary conception: to take the function as *stakeholder in a network of future-shaping disciplines* (-> **designing**).

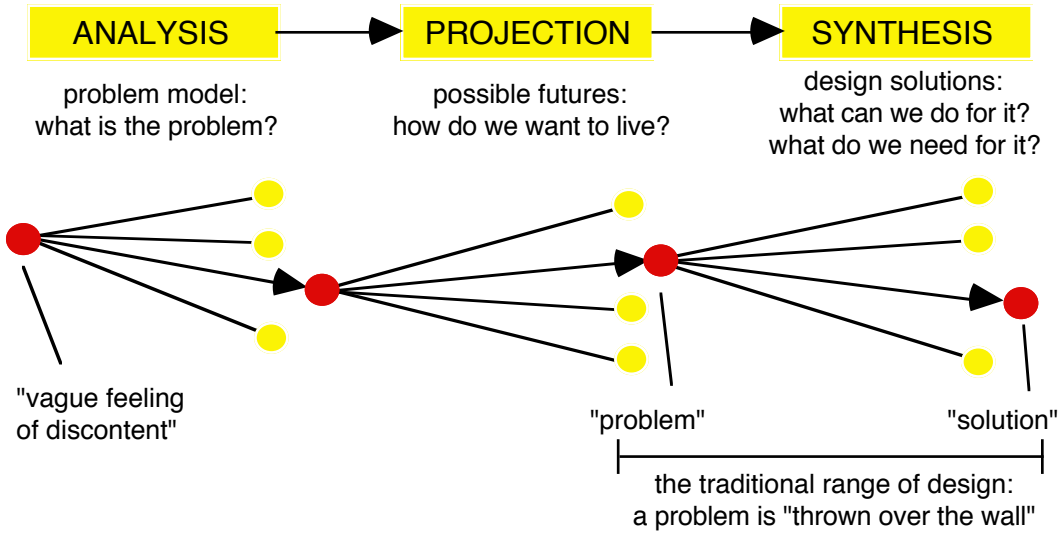

Fig. 5: Designing as a 3-step process of "problem-solving" (notice that the model is part of a bifurcation cascade!).

A 3-step model of the "problem-solving" process (ANALYSIS -> PROJECTION -> SYNTHESIS) is suggested. Transforming a "vague feeling of discontent" into a "solution" turns out to be a 3-step process of *reducing uncertainty (contingency)*. The traditional concept of industrial design neglects the first two steps and acts at the very end of the process (JONAS 1996 a, b).

New systemic approaches (see e.g. VESTER below) combine existing components into *integrated, flexible toolboxes*, more or less computer-assisted, covering ANALYSIS and part of PROJECTION. They are highly flexible allowing an integration of concepts. E.g. SENGE´s "Fifth Discipline" (=systems thinking) is based upon "Mental Models" and "Personal Mastery" (being important factors for ANALYSIS) and of "Shared Vision" and "Team Learning" (being essential in the PROJECTION step). The new systemic tools enable designers to act on several *levels of reality* and to communicate this in systemic "language". Observable events, trends, even patterns of behaviour are surface phenomena and show almost nothing about underlying structures.(SENGE 1990: 51-53):

"... The systems perspective shows that there are multiple levels of explanation in any complex situation, as suggested by the diagram below. In some sense, all are equally "true". But their usefulness is quite different. Event explanations - "who did what to whom" - doom their holder to a reactive stance. As discussed earlier, event explanations are the most common in contemporary culture, and that is exactly why reactive management prevails. ... Pattern of behavior explanations focus on seeing longer-term trends and assessing their implications. ... At least they suggest how, over a longer term, we can respond to shifting trends.
The third level of explanation, the "structural" explanation, is the least common and most powerful. It focuses on answering the question, "What causes the patterns of behavior?"

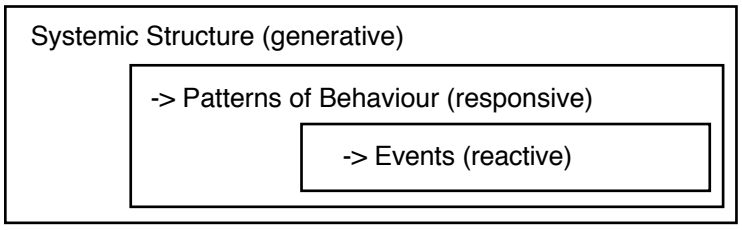

Fig. 6: 3 levels of reality.

Structural explanations are so important because only they address the underlying causes of behavior at a level that patterns of behaviour can be changed. Structure produces behaviour (SENGE´s "first principle of systems thinking"), and changing underlying structures can produce different patterns of behaviour. In this sense, structural explanations are inherently *generative*. Generative learning cannot be sustained in organizations where event thinking predominates. It requires a conceptual framework of systemic thinking, the ability to discover structural causes of behaviour.
The term "structure", as used here, does not mean the "logical structure" of a carefully developed argument or the reporting "structure" as shown by an organization chart. Rather, systemic structure is concerned with the key interrelationships that influence behaviour over time. These are not interrelationships between people, but among key variables (descriptors), such as population, natural resources, and food production in a developing country; or engineers´ product ideas and technical and managerial know-how in a high-tech company. SENGE (1990: 44) explains:
"But it is very important to understand that when we use the term "systemic structure" we do not just mean structure outside the individual. The nature of structure in human systems is subtle because we are part of the structure. This means that we often have the power to alter structures within which we are operating."

Furthermore the new tools enable designers to act on the different *levels of the design process*. An earlier work of the author (JONAS 1994) proposes a *systems theoretic framework for design* which is taken as an autopoietic system in an autopoietic supersystem (LUHMANN). The discipline is described as a cyclic multilevel communication process of production and consumption with partly deterministic / controllable and partly self-organizing areas, the emergent levels being:
- society,
- sub-systems (economy, science, ..., and **designing**),
- companies (the traditional design discipline was placed here),
- teams,
- individuals.

An essential point is the concept of **designing** (= Entwerfen) as an inter-disciplinary network of future-shaping disciplines situated on the level of sub-systems like science or economy with design as a partner. The argumentation was to strengthen theory work in the two outer boxes of fig. 7. It was possible to verify certain hypotheses comprising elements in two adjacent levels (or better: to reproduce certain observations) by means of system dynamics software (Stella II). Emergence- and attractor-phenomena could be visualized.

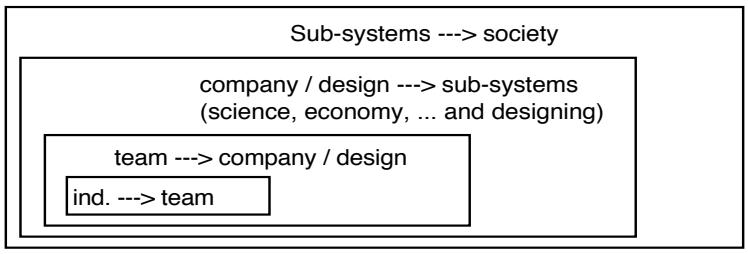

Fig. 7: 4/5 emergent levels of the design process (JONAS 1994).

COOPER / PRESS, in a very similar approach to viewing design as a process, identify four levels:
- design as an internal creative process,
- design as an external productive process,

- the total process of design within management,
- design as a planning process.

They explain (1995: 41, 42):

"The designer-maker producing one-off furniture thus sees design essentially in terms of an internal creative process, while a medium sized furniture business launching a new design every year or so will see it more as an external productive process that can be bought in and used when required. A large manufacturer of household goods may see design as a more integrated part of its total management process, while an internationally competitive firm in a rapidly changing sector such as consumer electronics may regard design as the planning process which expresses its cultural commitment to its product and keeps it ahead in the market."

6 Generative Tools - 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. SENGE refers to this principle as "leverage". 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.(SENGE 1990: 63-65):

The only 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. This is what makes life interesting."

How to understand the forces at play in those systems? 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; each of the "systems archetypes" (e.g. see figs. 2, 3; in detail see SENGE) suggests areas of high- and low-leverage change. Thinking in terms of processes of change rather than "snapshots" is another."

The key concept of systems thinking in practice is *Sensitivity Analysis* (Herbert SIMON 1978) based on appropriate problem models as

representations of real-world problems. See also WILLKE (1993: 221, 222). The aim is to reduce 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. This concept is essential to achieve at structural explanations.

Fig. 8 shows a set of variables and its potential impact on each other. It looks rather mechanistic but in fact it is the condensed outcome of intensive discussions in a team of stakeholders: concerning the meaning of the 13 variables and the strength and quality of 12x13 relations.

Wirkung von ↓ auf →	1	2	3	4	5	6	7	8	9	10	11	12	13				AS	P
1 Population	X	0	1	0	1	0	2	0	1	0	0	1	0				6	42
2 Number of Tourists	0	X	2	1	1	0	3	0	0	0	1	0	0				8	56
3 Economic Situation	2	0	X	2	2	1	2	3	3	3	2	2	1				23	299
4 Efficient Industry	0	1	3	X	1	0	2	3	1	1	2	2	1				17	272
5 Cultural Identity	1	0	0	1	X	2	1	0	2	2	2	3	0				14	238
6 Human Resources	0	0	1	2	2	X	0	0	2	1	1	3	1				13	117
7 Environmental Quality	0	1	0	0	2	1	X	0	0	1	3	1	0				9	153
8 Effic. Infrastructure	1	1	1	2	1	0	2	X	0	1	2	1	1				13	143
9 Educational Offers	1	0	1	1	2	2	0	0	X	1	1	2	1				12	144
10 Recreational Offers	1	0	0	0	2	1	1	0	0	X	2	0	0				7	98
11 Attr. Touristic offers	0	3	0	1	0	0	1	0	0	2	X	0	0				7	133
12 Future or. politics	1	0	2	3	2	1	3	2	2	1	2	X	2				21	378
13 Benefit Geo. Position	0	1	2	3	1	1	0	3	1	1	1	3	X				17	119
														X				
															X			
																X		
	7	7	13	16	17	9	17	11	12	14	19	18	7				PS	
	86	114	177	106	82	144	53	118	100	50	37	117	243				Q x 100	

Fig. 8: Cross-impact analysis, potential impact of key variables (descriptors) on each other.

Fig. 9. is automatically derived from fig. 8 and shows the systemic role of each of the 13 variables (active, reactive, critical, buffering, or neutral) thus giving important hints as to their sensitivity with regard to interventions. The

figures illustrate two steps out of a methodic toolbox which covers the ANALYSIS phase and is useful as a basis for the PROJECTION phase (VESTER 1993). They can be regarded as elements of the *systemic "language"* systems thinking is striving at.

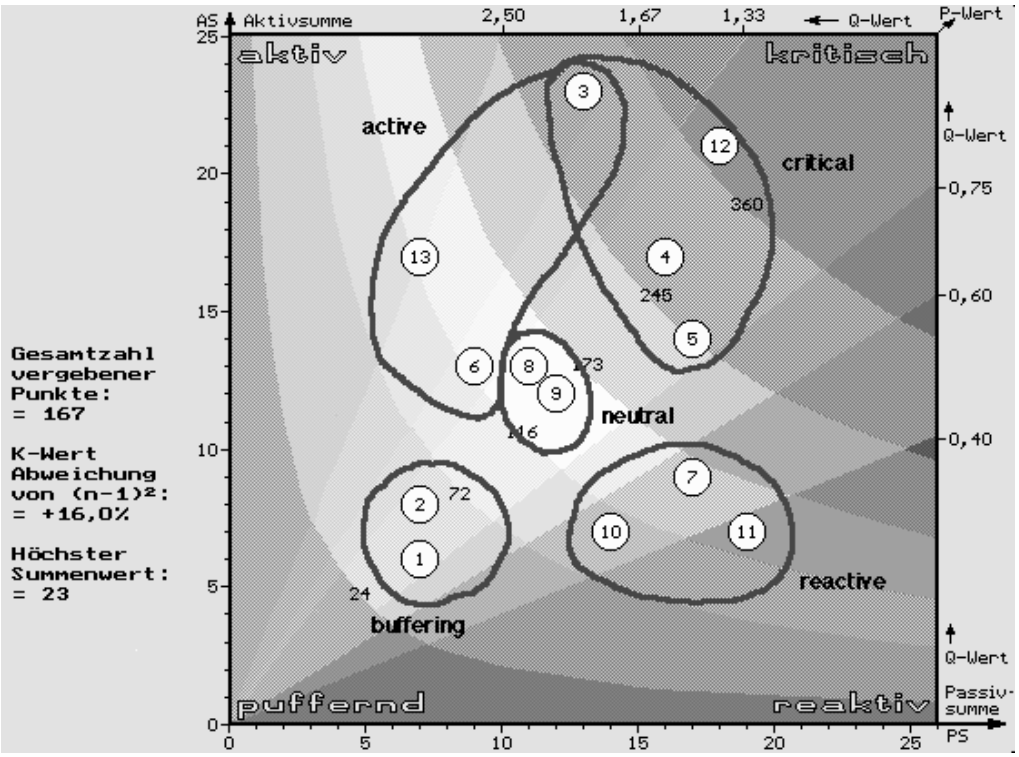

Fig. 9: Sensitivity map: roles of variables derived from cross-impact analysis.

To sum up the new methodic requirements. We need:

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.

Intervention strategies

Interventions have to be formulated in terms of the system in question. These "terms" contain the system´s identity. Thus 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.

Openness and interactivity

The character of 2nd order cybernetics depends on user-orientation and openness of the interaction process. An interactive approach yields not a forecast of events but rather insight into essential interdependencies within the system and - probably even more important - between the system and the users (which are stakeholders in a planning process). Thus we come to a close connection between the design process and the design product (design as the process of intervention). Problem and solution evolve in parallel during the process.

7 Challenging Perspectives - the evolving disciplinary self-concept

A complex systemic structure for the design discipline was presented, aiming at appropriate internal complexity in order to deal with increasing external complexity, not discarding but including the traditional concept of giving shape to an object to be industrially manufactured. Thus it is also a contribution to overcome those fruitless fighting as to "traditional" and "new" design. It consists of:

- 3 contextual phases (historical, sequential, overlapping, parallel),
- 3 process steps (expanding the "problem-solving" process),
- 4/5 process levels (generalization / aggregation, from creative to cultural processes),
- 3 reality levels (structure, patterns, events / objects).

The hypothetical social sub-system **designing** (on the level of science, economy, etc.) was introduced 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.

An important aspect is to strenghten the link to advanced management sciences. Design can be seen as part of management (in a broader concept) or rather *management as part of a broader concept of design*.

Systems thinking has as an *integrative potential* enabling design to act as an integrating discipline. Design already deals mainly with *meaning* (values, world views, etc.) as an integrating medium in complex systems rather than with the geometry of objects. And systems thinking has a *generative potential* if design is ready to fight and work hard for a share of definition power and responsibility for our future. This needs a strong commitment towards *continuous* theory and methods development in order to building a shared and growing body of knowledge. The promising reward could be increased *viability* of the discipline.

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