

On the Foundations of a "Science of the Artificial"

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Debates about the question of design becoming a discipline, a science, a system, or what the terms might be, still seem to be governed by the out-dated dualism of the "2 cultures". This leads to fierce struggles about the dominance, mainly from the side of the humanities (the "critical") vs. the sciences (the "useful"). I consider this attitude to be counter-productive. Both sides will contribute, and the process will initiate the emergence of something new, a kind of "3rd culture". The paper presents some elements and a structural design proposal for a "science of the artificial".

Summary and Conclusions

One of the most counter-productive consequences of the still vivid "2 cultures" dualism in design are fierce struggles as to the dominance, mainly from the side of the humanities vs. the sciences, with claims of (e.g.) "history, theory and criticism" to be the core of the new field (Margolin 1998). The blind spots caused by the own background are overlooked here. Contributions will come from both the humanities and the sciences. Fights for predominance are futile, because we will experience the emergence of something new, a kind of "3rd culture" (Brockman 1996), the culture of the artificial. The working / research process will be different, the methods used will be different, the outcomes will be different. The uniqueness has to be distinguished and indicated and communicated as precisely as possible in order to gain a status of autonomy comparable to that of the established disciplines.

The paper presents 9 independent chapters / essays, readable in arbitrary sequence, illustrating the conclusion that, so far, there are no foundations, but at best elements of a "science of the artificial". The sequence of reading creates perspectivity: 362880 different readings are possible. The paper reveals / creates a self-similarity of design as a discipline, design as a problem-solving process, and the design of the paper itself. Design theory is design! There will be no stable identity but only a dynamic one which is permanently re-established in communicative feedback practice. We should distinguish a structural meta-level of "strong theories" (Findeli 1998) (some elements presented here) and a processual, operative level of "weak theories", or "small theories". Maybe, in the future, a kind of "foundation" might crystallize from this dynamic process.

A final remark: The concept of "science" is preoccupied. In consequence its use would imply the realization of the ambitious project to redefine designing as the model of scientific research (Glanville 1982). So, provisionally (which might last forever), we should rather talk of a discipline or a system for the creation of the artificial, the exploration of the new.

Brockman, John (1996), *The Third Culture*. New York: Touchstone

Buchanan, Richard et.al. (eds.) (1998), *Doctoral Education in Design*. Proceedings of the Ohio Conference, Oct. 8-11, 1998. Pittsburgh: School of Design, Carnegie Mellon University (POC)

Findeli, Alain (1998), *A Quest for Credibility: Doctoral Education and Research at the University of Montreal*. In: POC pp 99-116

Glanville, Ranulph (1982), Why Design Research? In: Jacques, R.; Powell, A.(eds.) (1980) Design: Science: Method. Guildford: Westbury House
Margolin, Victor (1998), History, Theory, and Criticism in Doctoral Design Education. In: POC pp 197-206

dynamic identity, floating subject matter, no paradigmatic core

The problem of fixing the core of designing is stated again and again. BUCHANAN (1990) takes "the conception and planning of the artificial" as the central theme of design: "... What makes design studies systematic is the attempt to focus attention on basic issues in the nature and practice of design. Three issues are central: (1) the subject matter of design, (2) the methods of design thinking and working, and (3) the purposes or goals sought in design. ..."
He makes the point that design is pulled toward art and aesthetics, toward engineering and the natural sciences, and toward the human sciences. And he clearly states that the purpose of design studies is to find a center among these tensions and, thereby, establish the identity of design thinking in the modern world: "To the degree that this is accomplished in the 1990s, design studies will have made a useful contribution."

Where are we now, a decade later, at the end of the 1990s? There are good questions but only few answers. (1) As to subject matter (Buchanan 1998): "We have turned from a central occupation with 'signs and symbols' in graphic design and 'things' or 'artifacts' in industrial design, and we have turned towards 'action' and 'environment' as the fundamental terms of practice and reflection." This is an accurate description. But is it progress or just adaptation to changing contexts, to the fact that things are recognized as being more and more interconnected? (2) As to methods I see an increasing pluralism, more colourful approaches, the whole range from ethnology to systems thinking. But is it progress or a response to the failing of traditional approaches? (3) As to purposes or goals: Is there any universal goal apart from the commonplace of increasing the quality of living? Or is purpose-orientation the ultimate goal, creating identity through permanently pursuing temporary goals (transforming system state 1 into system state 2).

Is there hope to find a center, a unique "nature"? The close reference to established bodies of knowledge (arts, sciences, technology, etc.) has not been really successful, as examples (Bauhaus, New Bauhaus or Ulm) prove. At least they are neither universal nor eternal. We have to face the confusing and disillusioning fact that at the core of the discipline there is no fixed, "eternal essence". The central concepts are perpetually created and recreated in language and action, without a fix external reference. Design is in a process of co-evolution of artifacts with their cultural contexts.

Meaning is not the result of blueprints. Meaning is created in the recursive self-description of complex systems. Meaning, as the glue for dynamic stability and cohesion of the discipline, has to be (re-) produced in a continuous process of interaction, struggle, and negotiation between the discipline and its contexts. This change process can be considered as a learning process, and, at the same time, a design process. So we are faced with a dynamic stability, a floating basis. As soon as the dynamic stops, the disciplinary identity (meaning) will die.

Maybe the present manner of discussing design is the ultimate level, in comparison to disciplines with more fixed subject matters. Maybe this is not a deficit which can be removed but an essential characteristic of the discipline. Maybe we should stop talking about the not-existing core, stop complaining about the lacking knowledge base. It is our quality, not our deficit.

Buchanan, Richard (1990), *Myth and Maturity: Toward a New Order in the Decade of Design*. In: *Design Issues* Vol. 6, No. 2. Cambridge: MIT Press

Buchanan, Richard (1998), *The Study of Design: Doctoral education and Research in a New Field of Inquiry*. In: *POC* pp 1-29

a process discipline of professional dilettantism

What is the character of the discipline? Imagine e.g. medicine: the essential reference frame or criterion for disciplinary expertise is the actual process quality, not the history / sociology / psychology / etc. of medicine. Design is a cultural and economic and a professional process, or, more precisely, a way of projective thinking, planning, and communicating, not based on a set of universal values and objectives, but on criteria of appropriateness and process quality. The crucial problem for design practice and design education today is how to make this process more sound, more transparent, and more communicable, and how to integrate it into the economic planning process. Emphasis on the process with its purpose orientation and pressure of time is necessary if we want to develop this discipline as one which shapes the world through projection. The central means and ultimate goal is the process of intervention into complex social systems (Krippendorff 1994). Jonas (1998) gave a functional definition of design as:

- use-oriented (with quality of life as criterion, without claiming to know what this is),
- illustrative (creating wholes, contexts, narratives, aiming at agency),
- anticipative (looking ahead, in different directions and time scales),
- generative (aiming at the synthesis of structures, patterns of behaviour and artifacts),
- integrative (neglecting disciplinary boundaries, moderating perspectives, including its own),
- context-sensitive (being aware of and using social, cultural, technological interdependencies).

Wiener (1948) stressed that he was convinced that the most promising areas for the progress of science were those being neglected in the no man's land between the established disciplines. Design's situation is even more extreme: Design is the expert discipline for relating and connecting floating fields. The subject areas between which to act as an interface are changing. It's own field is a kind of no man's land. As a consequence we should not carry the respect for the established scientific disciplines too far. Instead we should strive at the development of a "professional dilettantism". We should take our function as a court-jester very seriously: supporting scepticism, opening up narrow views, removing ossifications, etc.

The emphasis on operationalization combined with the feeling of scientific shortcomings leads to the development of design methods; frequently consisting of three main steps: "Traditional" methods distinguish analysis ---> synthesis ---> evaluation. Jones (1970) considers this too narrow and proposes divergence (un-learning) ---> transformation (generating a new option, conflict resolution, not compromise) ---> convergence (comprises the traditional analysis - synthesis - evaluation). Jonas (1998) introduces analysis (dealing with complexity on the problem side) ---> projection (dealing with contingency on the solution side) ---> synthesis (comprises the traditional analysis - synthesis - evaluation). There are countless other possible ways. Methods will never be secure recipes but rather post-rationalizations of highly contingent processes. At best they serve as check-lists in the educational or professional process to make sure that you have not forgotten any of the known aspects. And we should keep in mind the context-dependency. Methods too are a matter of fashion. There is no progress in methodology as contexts and subject matters are evolving together.

Jonas, Wolfgang (1998), Viable Structures and Generative Tools - an approach towards "designing designing". In: contextual design - design in contexts, 23 - 25 April 1997.

Stockholm: the european academy of design

Jones, John Christopher (1970), Design methods: seeds of human futures. New York and Chichester: John Wiley & Sons

Krippendorff, Klaus (1994), Redesigning Design. An Invitation to a Responsible Future. In: Design - Pleasure or Responsibility? Selected and edited articles from the International Conference on Design, 21-23 June 1994. Helsinki: UIAH

Wiener, Norbert (1948), Cybernetics or control and communication in the animal and the machine. Cambridge: MIT

teleology, projection, and uncertainty

Design thinking means the permanent urge of exploring futures, anticipating change (on different levels of time, scale, abstraction, etc.), and putting it to discussion, thus initiating discourse and increasing the variety of choices. This forward-orientation in time relates design to the field of Futures Studies. Rosenblueth, Wiener and Bigelow (1943: 23) re-introduce the concept of teleology which "... has been discredited chiefly because it was defined to imply a cause subsequent in time to a given effect. ... Since we consider purposefulness a concept necessary for the understanding of certain modes of behavior we suggest that a teleological study is useful if it avoids problems of causality and concerns itself merely with an investigation of purpose."

Design is acting as an intelligent sensor and a projective feedback medium of comparatively exploring the tension of the existing and the potential. Dilnot (1998: 69): "... what design, as a mode of transformative action, allows us to see is how we negotiate the limits of what we understand, at any moment, as the actual. In design, in other words, we begin to see the processes whereby the limits of the actual are continually formed and re-formed." Designing means building perspective projections of the present, which are related to our wishes, fears, and expectations.

Buchanan (1998: 6-8) distinguishes the paleoteric way of knowing (looking backward, working with knowledge) and the neoteric way of knowing (looking forward, working with designing): "Paleoteric thinking is based on the identification of discrete subject matters, such as we find throughout the university today. The goal ... is to expand the knowledge of a particular subject matter, often in greater and greater detail. In contrast, neoteric thinking is based on new problems encountered in practical life and in serious theoretical reflection. ... Designers create their subject matter in a way that natural scientists and social scientists do not. If we do have a subject matter in design, it is the activity of making and the results of making that emerge in human-made products. ..."

The criterium is meaning and purpose-orientation, which cannot be generalized but can only be derived from acting and making and producing, always with respect to concrete cases. Truth has to be replaced with meaning and appropriateness.

Thus design cannot rely on knowledge, because knowledge describes the existing. Instead we have to deal with goals, purposes, teleological judgements, evaluations. The resulting non-linearity of the system's behaviour, fluctuation of parameters etc. leads to contingency on the solution side. Dilnot (1998) refers to design as a "science of uncertainty". The uncertainty of emergent patterns creates surprising effects and insights. Irony, phantasy, joke are essential elements of design thinking in its jester function.

Design thinking is different from scientific thinking (analytic, reductionist, aiming at explanation), it is different from engineering thinking (aiming at efficient functionality), and it is different from artistic thinking (taking the artist's self as primary criterion). For all these reasons design thinking has to claim theoretical and methodological autonomy.

Buchanan, Richard (1998), The Study of Design: Doctoral education and Research in a New Field of Inquiry. In: POC pp 1-29

Dilnot, Clive (1998), The Science of Uncertainty: The Potential Contribution of Design to Knowledge. In: POC pp 65 - 97

Rosenblueth, Arturo; Wiener, Norbert; Bigelow, Julian (1943), Behavior, Purpose and Teleology. In: Philosophy of Science Vol. 10 January 1943 No. 1 pp 18-24

organized complexity, feedback-control, the edge of chaos

WEAVER (1948) distinguishes three problem types:

(1) Classical physical science before 1900 was largely concerned with two-variable problems of simplicity; whereas the life sciences, in which these problems of simplicity are not so often significant, had not yet become highly quantitative or analytical in character. Problems of Simplicity are reversible and conservative in character.

(2) The application of new methods of statistical mechanics to large numbers of objects / variables made it possible to deal with Problems of Disorganized Complexity. Each of the variables has a behavior which is individually erratic, or perhaps totally unknown. Despite of this the system as a whole possesses certain orderly and analyzable average properties. Closed systems of this kind tend towards maximum entropy and show irreversible behaviour.

(3) There is a middle region in between where problems show the essential feature of organization. Problems of Organized Complexity are those "... which involve dealing simultaneously with a sizable number of factors which are interrelated into an organic whole." Social, economic, ecologic systems are of that kind, including the concept of autopoiesis.

Weaver (1948: 540): "These new problems, and the future of the world depends on many of them, requires science to make a third great advance, an advance that must be even greater than the nineteenth-century conquest of problems of simplicity or the twentieth-century victory over problems of disorganized complexity. Science must, over the next 50 years (1948-1998, W.J.), learn to deal with these problems of organized complexity."

Complexity on the problem side (how to describe the situation) corresponds to contingency on the solution side (how to change the situation into a preferred one). Organized complexity means the end of linear causal chains and creates feedback mechanisms. Simple feedback mechanisms are able to create chaotic behaviour. The formula $X(n+1) = 4\lambda X(n) (1-X(n))$ creates bifurcation cascades: the higher the parameter λ (distance from equilibrium, energy / information throughput), the closer the system moves to the edge of chaos, the more complex and the more unpredictable are the patterns of behaviour that emerge. The closer to the edge of chaos the design system is acting, the more sensitive it is to accidental fluctuations and the farther its considerations reach into uncertain futures. Jonas (1998) describes 3 design contexts (need, need of need, orientation) which can be classified by their rate of energy throughput. See also Dilnot's (1998) notion of "negotiation of the limits of what we understand, at any moment, as the actual." Design as a complexity-reducing medium of constructing the world is exploring the space of possible alternative futures.

The epistemology of radical constructivism (von Glasersfeld 1984) describes the active recognition of the world as design. Man can understand only what he produces according to his own plan. Planning, order, prognosis are obsolete, the only chance is permanent trial-and-error as strategy. That does not mean muddling through (planning is necessary and impossible), but the plan has to work as a sensor, a learning device, in a highly complex (nearly chaotic?) environment. Planning will be replaced by feedback-control. Cybernetics = the art of navigation. Feedback-learning through making and using and reflecting is an autonomous "third way" of producing knowledge of what COULD BE.

von Glasersfeld, Ernst (1984), Einführung in den radikalen Konstruktivismus. In: Watzlawick, Paul (ed.), Die erfundene Wirklichkeit. München: Piper pp 16-38

Dilnot, Clive (1998), The Science of Uncertainty: The Potential Contribution of Design to Knowledge. In: POC pp 65 - 97

Jonas, Wolfgang (1998), Viable Structures and Generative Tools - an approach towards "designing designing". In: contextual design - design in contexts, 23 - 25 April 1997. Stockholm: the european academy of design

Weaver, Warren (1948), Science and Complexity. In: American Scientist 36 pp 536-544

design as social system

According to Luhmann (1984) the differentiation of modern societies leads to the emergence of highly specialized, efficient, operationally closed (autopoietic) social subsystems. They

realize their autopoiesis (generating meaning) through communication using generalized media and special codes. These are the legal system, science, economy, art, etc. Economy, for example, is acting in the medium money using the binary code pay - pay not.

Systems thinking, especially sociological systems theory, provides some useful tools to describe design as a highly complex multilevel system, thus making the meta-discourse more efficient and purpose-oriented. There are the following levels of the social communicative system / process: individual, team, organization, social subsystem / disciplinary system, and society as a whole. There are the levels of reality (Jonas 1998): events / objects, patterns of behaviour, structures, and visions. And there are three levels of observation, necessary for dealing with the blind spots of the lower levels:

- (3) the meta-level of epistemology and the manner how theories and methods evolve in time ("strong theories"),
- (2) the level of operative theory / "small theories" ("weak theories") / methods, from wherever they may be taken,
- (1) the operative level of making.

The hypothesis is to conceptualize design in a wider sense as a social subsystem of this kind. What is "design in a wider sense"? Simon (1969) called it the "Sciences of the Artificial". I called it the network of future-shaping disciplines (Jonas 1994). In the context of this discussion one could call it a projective discipline (acting as an expert for dynamic relations - interface). This hypothetical social subsystem is working in the medium design with the code problem - solution. Design is the medium of dealing with the possible in the temporal, the factual, and the social dimension.

This sounds rather vague, but it seems to be necessary to have some more general concepts in order to avoid futile fights between product- and scenario people or between material and immaterial design, etc. The systemic approach is able to conceptualize design or the hypothetical social subsystem design as a "learning" system. There might be further differentiations as: Futures Studies (design acting as sensor, scout, jester, ...), Management of meaning (design as cultural industry), Strategic design (design as a strategic planning tool), Product design (material, immaterial objects, the traditional concept), Service design (designing invisible structures, stimulating behaviour), etc.

Of course this is one proposal for a meta-theory. It is a hypothesis formulated in a specific terminology (because this is my preferred field), but not in the attitude of excluding other proposals. One has to make a (contingent) decision in order to be able to develop a system of argumentation. On a fourth (meta-meta-) level of observation one could identify the blind spots of this decision.

On the level of operative theories I am supporting a „real“ pluralism of theories and methods. The framework / network presented here allows for this. To claim that „this and that“ be the core of the discipline (Margolin 1998) is a somewhat totalitarian, highly static, a-historic perspective, neglecting the own involvement in the process.

Jonas, Wolfgang (1994); Design - System - Theorie. Überlegungen zu einem systemtheoretischen Modell von Designtheorie. Essen: Die Blaue Eule

Luhmann, Niklas (1984), Soziale Systeme. Frankfurt / M.: Suhrkamp

Margolin, Victor (1998), History, Theory, and Criticism in Doctoral Design Education. In: POC pp 197-206

Simon, Herbert A. (1969, 3rd ed. 1996), *The Sciences of the Artificial*. Cambridge: MIT Press

an interface discipline without progress

The concept of interface is central for designing. Bonsiepe (1996) focusses on the interface man - artifact with design as the expert discipline responsible for optimizing this relation. Simon's notion is wider and more powerful, considering the relation artifact - design - context, with design being centrally involved (1996: 6): „An artifact can be thought of as a meeting point - an 'interface' in today's terms - between an 'inner' environment, the substance and organization of the artifact itself, and an 'outer' environment, the surroundings in which it operates.“ Buchanan (1998) calls design a "transdiscipline". A further notion could characterize design as acting at the interface between what IS and what COULD BE.

Design means the active mediation and conciliation of a number of requirements: function, aesthetics, identity, need for ..., etc. This is a dynamic process including culture, technology, politics, society, Buchanan (1990) emphasized the role of design in interpreting and expressing culture at large. All this results in the importance of communication with each other, with other disciplines, and of course with the public / consumers. This demand for intra- and interdisciplinary communication through visual and verbal means ("systemic meta-language") is well-known for many years. There seems to be no progress in this issue.

Therefore we should ask: can there be progress in design? What is progress in design? What are the criteria? There is a fundamental difference compared to the natural sciences. The latter have a rather stable reference system; their subject is "nature". Even if we consider that "objective" knowledge is impossible, something like progress cannot be denied as the development of technology indicates. Design, on the other hand, has two evolving reference systems and nothing else. There is the evolving artifact ("moving targets") before the background of its ever changing environment (culture, technology, ...). Design is forced to perform a permanent effort of adaptation of the artifact's strengths and weaknesses and the environment's opportunities and threats. Maybe we have to conclude that this process can never be really generative.

The sciences can act as if they were standing outside as external observers of reality. Criteria of truth are fixed, at least for a while. There were periods in history when design contexts were relatively stable too and design could have the illusion to contribute to the satisfaction of "real" needs, to work for the "progress of mankind". Today design can only be conceptualized as an active participant in the network, deeply involved in the process of negotiating temporary criteria and reference systems to be used for design work ("at the edge of chaos").

The reflection of this involvement, the role as an interface is necessary to prevent schizophrenic phantasies of omnipotence as well as of impotence. Design cannot contribute to the realization of idealistic goals, but it can indeed contribute to the evolutionary process of proceeding. As a partner in the network of future shaping disciplines it has control of certain feedback instruments (visualization, modelling, mediation). Design must cope with self - referentiality and involvement. Theory has to be able to explain its own emergence. And design must accept the paradox of theory having to explain its own change. Design theory is dynamic without ever becoming „more true“. It might be disillusioning or challenging: There will be no fixed external point of reference - never!

Bonsiepe, Gui (1996), *Interface. Design neu begreifen*. Mannheim: Bollmann
Buchanan, Richard (1990), *Myth and Maturity: Toward a New Order in the Decade of Design*. In: *Design Issues* Vol. 6, No. 2. Cambridge: MIT Press
Buchanan, Richard (1998), *The Study of Design: Doctoral education and Research in a New Field of Inquiry*. In: *POC* pp 1-29
Simon, Herbert A. (1969, 3rd ed. 1996), *The Sciences of the Artificial*. Cambridge: MIT Press

a "historical" discipline

Design can be conceptualized as a feedback-system, an autopoietic system, a nontrivial machine, a social subsystem. Bifurcation cascades illustrate the transformation of historical trajectories (post-rationalizations, constructions too) into myriads of uncertain future possibilities. The present situation ("today") of the discipline, of culture in general, is a product of its history. Who defines which elements are part of this history? We are positioned somewhere in the cascade ("today") according to the throughput of energy / information λ (we can call this parameter "cultural velocity"). The contextual phases (need / need of need / orientation / ...) might be related to points on the λ axis.

Today we are facing complexity / chaos as closely as never before. The closer we are to the right end / the edge of chaos, the farther the consequences of our decisions will reach into highly uncertain futures. The stronger we need to zoom into the structure of bifurcations in order to illuminate our range of options.

At any point of the process we are dealing with the whole of history and are facing the whole of the future. Allen (1982: 110) compares this to the process of paper-folding (Origami): "Again, the new scientific view is found to be a recognition of the limits to 'control' or 'design freedom'. First, there is the unpredictability related to bifurcation phenomena, and, second, there is the fact that one must take into account the internal structures 'accumulated' in a system by its previous passage through bifurcations and along certain branches. The system is partly a memory of its past, just as in the origami example, the 'essence' of a bird or a horse is both in the nature and in the order of the folds made. The question that must be answered when faced with a problem of planning or design in a human system is, what exactly is the system? ... so it is necessary to know the nature of the inner structure before plans can be made. ..."

Design history is an immanent part of design. This is different to other scientific disciplines. There are always (unavoidable) remnants of former glory, appreciated and admired or hated like the plague. Nothing is really entirely new, everything is based on archaeological sediments. None of the many branches really ever "dies". Instead they "sleep" for a while and differentiate according to new impulses / fluctuations from inside and outside the discipline. So it is short-sighted to claim that certain approaches have "proven" their uselessness (e.g. systems thinking in design). Of course one can deny the relevance of a certain historic event / period / approach, but even this denial shows that it has exerted an irreversible impact. All this is the reason for the obvious "temporalization of theory" in design. We have "theory

generations" which are not "true" or "false" but "fashionable" and "appropriate" or "outdated" and "inappropriate".

Maybe "history" in this sense is the only true knowledge base of the discipline? Not in the sense that historical knowledge be the prerequisite for design expertise or that design history be the core of design as an academic discipline but rather as the growing sediment of past discourse that creates the stable intellectual foundation for essentially unstable and risky and explorative action.

There seems to be self-similarity of the disciplinary process as a whole and every single design process. The form of this paper tries to reflect this.

Allen, P.M. (1982), Evolution, modelling, and design in a complex world. In: Environment and Planning B, 1982, volume 9, pp 95-111

uncritical and amoral, but responsible

Design is uncritical, because it has to be. There is no and there has never been a direct perception of the world. Instead we have the perception of communication, the observation of observations (2nd order cybernetics). So it becomes difficult or impossible to evaluate the representations of reality by comparing them with reality itself. Pure criticism, whatever that might be, is not really useful in the process. Where is the pivotal point to evaluate what is good or bad? That means for some intellectuals: their favourite toy, critical theory, will break. Criticism will be replaced by performance. We have to focus on the process. Design can be "critical" only in the sense that it illustrates different choices and puts them to discussion. Design itself has no criteria that enable decisions as to "good" or "bad" solutions.

We should think of replacing normativity (criticism) by "teleology" (purpose orientation) and effectiveness. Rosenblueth and others (1943) re-introduced the concept of teleology into science. The critical attitude should better be transformed into an ironical attitude (Rorty 1989). Phantasy, joke, provocation, intervention, etc. are elements of design's role as a modern court jester.

Design is amoral. The claim for ethics as a major criterion in design seems to be off the point, a symptom of immaturity. Ethics should be kept implicit in the process by using the appropriate methodical tools and communicative styles. We need a moral disarmament of design in order to become acceptable to other disciplines. Margolin (1998) criticizes Simon's (1996) definition of design as "transforming existing situations into preferred ones" as "deceptively catholic". But can there be a more challenging task than this? And a more responsible one? The main characteristic of many approaches from the humanities, as e.g. "criticism", is not their deepness or richness or whatever value but their fuzzyness and uselessness in current practice. "Humanistic" attitudes are not really useful in a time where the "human measure" is an increasingly inappropriate criterion (information,

nanotechnology, genetic technology, etc.). Only by dropping idealistic and rigorous concepts of humanism will we be able to work for real people in their individuality. It makes no sense at all to work for "mankind" or for "the environment".

Design is responsible for what it is doing. Responsibility is only possible if we do not retreat to moral positions. There was the time when designers thought they would transfer real problems into real solutions. Today we know that these are just codes indicating the starting point and the endpoint of a project. It is more appropriate to talk about transferring system state 1 into system state 2, always having in mind the complexity of state 1 (perspectivity of problem design) and the contingency of state 2 (there are many possible states 2). Contingency is inherent in the process. Responsibility is required to deal with this perspectivity in a democratic manner, to support, for example, error-friendliness. What we need are the most advanced ("fashionable") communicative methods.

Designers cannot act as moral guards but rather as scouts, sometimes as jesters, hopefully as respected partners in a network.

Margolin, Victor (1998), History, Theory, and Criticism in Doctoral Design Education. In: POC pp 197-206

Rorty, Richard (1989), Contingency, irony, and solidarity. Cambridge University Press

Rosenblueth, Arturo; Wiener, Norbert; Bigelow, Julian (1943), Behavior, Purpose and Teleology. In: Philosophy of Science Vol. 10 January 1943 No. 1 pp 18-24

Simon, Herbert A. (1969, 3rd ed. 1996), The Sciences of the Artificial. Cambridge: MIT Press

the circularity of making and reflecting

The slight hystery regarding the scientific or humanistic foundations of design are a consequence of the misconception that this dualism is of any importance for design. The complaints about the dominance of "rationalist" thinking (if it has ever existed in the 1960s) is groundless. The concept of the "2 cultures" is evolving towards the idea of a "Third Culture" (Brockman 1996). There seems to be a basic language problem: The deepness, richness, etc. of the language of "history, theory & criticism" is not more than fuzzyness with respect to the very prosaic purpose-orientation of design activity.

The concept of design acting in language, emphasizing communication, negotiation, observing observations (2nd order cybernetics, product semantics) was a big step forward. But what is missing is the element of making which has to be included into the feedback circle. Without material intervention into social systems there would be no active change. Schön (1983) introduced the concept of reflection in action. Simon (1996) created the „Sciences of the Artificial“ which have a strong scientific bias, but emphasize the difference from scientific activity. One of the most important contributions of the last years - in my view - was Frayling's (1993) distinction of research about / for / through design. It made explicit (by naming it) the specific nature of design research. Designerly knowledge production is done

in the process (through design), Findeli (1998) calls this „strong theory“. Approaches from the humanities (about) or the sciences (for) are labelled „weak theories“.

All this is not really new. Aicher (1991) postulated in Ulm that we have to change from thinking to making in order to learn new thinking through making. He saw knowledge production as work in the form of making, i.e. making models that can be compared. Knowledge is the indication of differences. The comparison of alternatives will reveal the better, the more appropriate. Design is a discipline of knowing by doing by knowing by ... , a discipline whose essential characteristic (and problem!) is the necessity of permanent learning (without any "progress" in the scientific sense). Aicher illustrates his design perspective in a nice article on the influence that Ludwig Wittgenstein's experience of building a house for his sister had on the development of his philosophy (1991: 127):
... ist der schluß naheliegend, daß es die tätigkeit an diesem bau war, die ihm den schlüsselbegriff seiner zweiten philosophie, den "gebrauch" beibrachte, erfahren ließ, nahelegte und eingab. das haus, das als erscheinungsbild den "traktat" verkörpert, wäre demnach gleichzeitig die schule seiner zweiten philosophie, und seine zweite philosophie wäre eine solche des entwurfs, einer lebensform, es wäre die schule, daß man durch den gebrauch als eigene aktion und durch den gebrauch als kriterium an sich selbst und an die dinge herankommt. ...

This leads to the conclusion that design theory / research is design itself. Mitchell (1993: 37) argues that "design research, to be effective, must not consist of ideas about design ... but rather must be design itself." This is an observation on the structural (meta-) level of research / theory ("strong") through design which has to be elaborated. Beside that we have the operative level where we apply numerous ("weak") theories and methods from the natural sciences, the humanities, social sciences, etc. in order to produce knowledge for and about design.

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