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ABOUT THE NEED FOR THE DESIGN POLICY

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ABSTRACT

Generating knowledge about design is the goal of discipline-oriented, scientific research of the design science community. Theoretical research into engineering design has grown into field of a significant complexity.

Orientation in the "jungle" of discipline-oriented research causes problems not only to new researchers but also to specialized experts due to high segmentation and multi disciplinary aspects of the matter. There have been numerous attempts to systematize the field in order to enable further research directions. An alternative approach would be to reconsider the complexity from a broader aspect. The paper gives a brief description of the current situation in the design community, and advocates for a new approach by introducing a need for comprehensive design policy.

The policy of design research community has not yet been outlined. This article proposes a systems description of design policy and the process of generation and implementation.

INTRODUCTION

Generating knowledge about design and for design is the goal of discipline-oriented, scientific research of the design science community. This knowledge is the primary development force of the engineering design. Since the first works of Hansen, Roth and other pioneers of the field in the middle of the 20th century the theoretical research into engineering design has grown into a field of significant complexity. Therefore, it is not easy to see the trends of evolution, to identify the landmarks of development, to judge the scientific significance of various approaches, and to decide on the target fields for investments.

Orientation in the "jungle" of discipline-oriented research causes problems not only to new researchers but also to specialized experts due to high segmentation and multi disciplinary aspects of the matter. An alternative approach would be to reconsider this complexity from a higher level. Therefore this paper is not about rigorous academic research, nor about reporting scientific results. It is merely a speculation about the current momentum in the design community, an embryonic idea, sketching a new approach by introducing a need for the design policy. This paper will focus will on the current situation, briefly outlining the goals of the design research community during the last 30 years and emphasizing the need for comprehensive design policy. The policy of design research community has not yet been outlined. This article proposes a systems description of the design policy and the process of its generation and implementation. The lack of empirical evidence is obvious, therefore this paper should be viewed as a contribution to further discussion.

THE CONTEMPORARY DESIGN RESEARCH

The suitability of design theory and practice to meet global challenges of product development has been researched, practiced and thought by many groups and individuals. The recently published papers on respectable design conferences (ICED series on the global scale, DESIGN conferences in Dubrovnik, for instance, on the local level) manifest the scientific improvement and increased research rigor.

In his paper "Engineering design research: anno 2000" [1] Horváth advocates a need for a comprehensive but, at the same time, sufficiently articulated vision reflecting the current state-of-the art in the design science and projecting ahead to the near future. Recognizing achievements as "…enormous efforts have been and are being made towards scientific understanding,

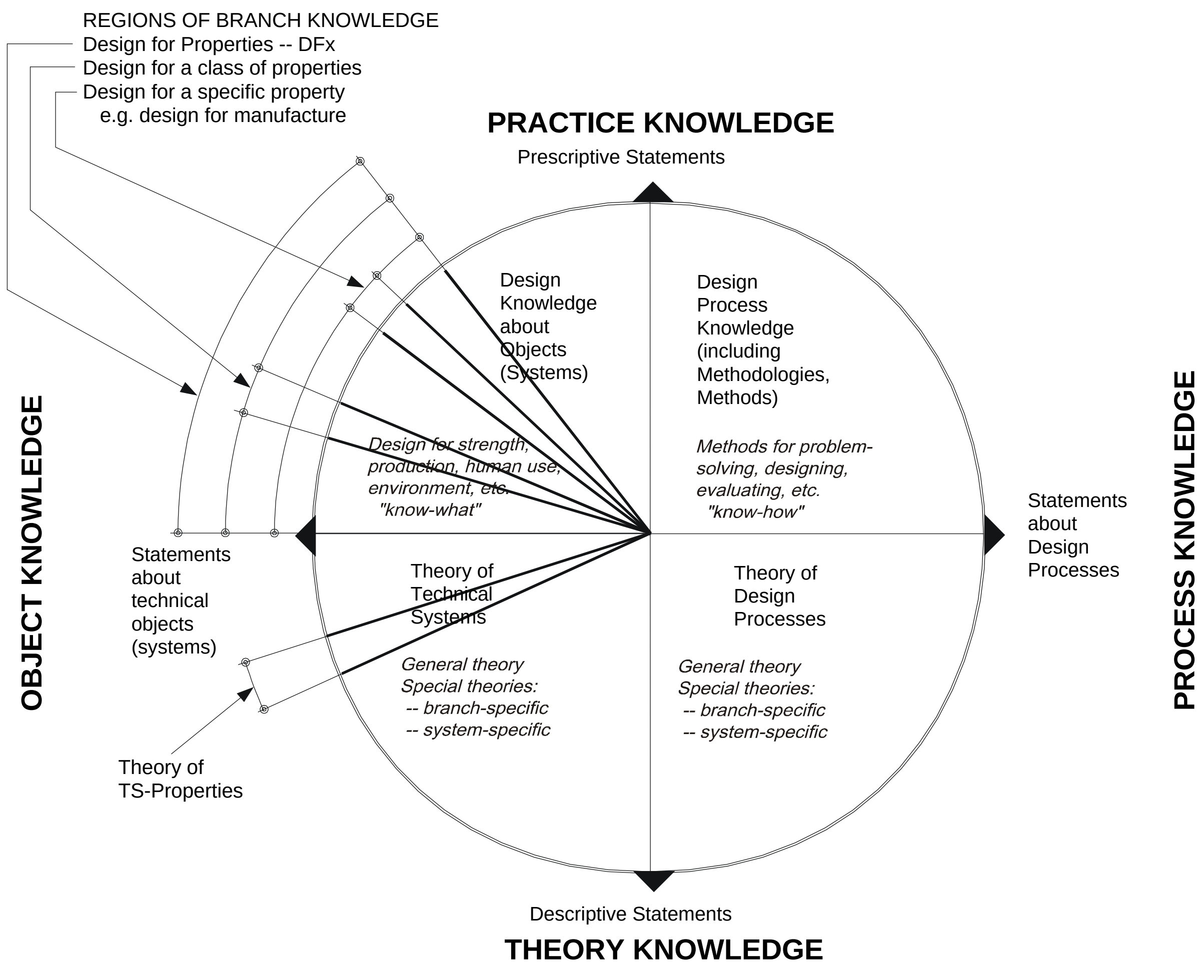

Figure 1. Categories of engineering design knowledge

technological underpinning and practical exploitation of engineering design. Research approaches design from several aspects such as governmental, industrial, historical, technological, educational, scientific, sociological, and

practical. Researchers usually focus on a target application field (e.g., architectural, mechanical, electrical engineering) and narrow down their scope to problem areas such as conceptualization, detail design, computer support, and product realization." Numerous proposed and developed CA tools have been used as a proofing mechanism for a particular research thesis, leading to an exponential growth of scientific publications on technical issues of engineering design. Indicating a need for a different, broader approach Horváth indicates a lack of research papers "addressing philosophical, epistemological and teleological issues of design". Some authors have provided outstanding (systematic) surveys about the fields of attention and approaches of academic and/or company research [2,3,4,5,7]. In order to arrive at a systematized discussion, they introduced various reasoning schemes. The basis of these schemes ranges from a simple chronological principle, through a phenomenological classification, to a contextual taxonomization."

A number of attempts to define the field of design research can be found in literature. Design and science have traditionally been viewed as separate fields, with the latter producing the knowledge on nature and the former using such knowledge to perform actions upon nature itself. Such a perspective is close to the Aristotelian distinction between "episteme" producing "theoria" and "techne" aiming at "poiesis" (i.e., producing new things). Modern students of technology [6, 7] have shown that, even if technology is indeed related to science, the technological knowledge is something different from and richer than simply "applied scientific knowledge". Other authors, such as Simon [8], suggested the development of a "science of design" as "a body of… analytic, partly formalizable, partly empirical, teachable doctrine about the design process". Simon considered design broadly, as a process defining a course of action "aimed at changing existing situations into preferred ones".

Hubka and Eder [9] viewed “design science” as a comprehensive body of knowledge which includes four underlying categories (Figure 1):

- theory of technical systems,
- design theory and theory of design processes,
- special technical information and applied knowledge from natural and human sciences, and
- design methodology.

The work of Hubka initially published in German has received wide attention after it had been translated into English by Eder. They worked together on the refinement of statements and content in order to relate design to science, thus defining design as scientific discipline and not merely skill and art. So far their book on Design science has been published in dozen languages.

Analyzing the relations between design, science and technology, Cross [10] distinguished the following activities:

- “scientific design” (i.e., when design is a subject that uses scientific knowledge),
- the “science of design” (i.e., when design is viewed as a phenomenon and is a passive object of scientific analysis),
- “design science” (i.e., when one makes design happen in a scientific way through methods and tools, and design is an object to which scientific knowledge is applied).

A general and multi-view survey of the many streams of design research was published by Finger and Dixon [2] over a decade ago.

Horváth et al. in the research presented at Design 2000 conference [1] argues a multi-level taxonomical framework in order to systematize the research aspects and approaches of engineering design. The authors identify the following contextual categories of engineering design research: (i) human assets, (ii) design knowledge, (iii) design philosophy, (iv) design theory, (v) design methodology, (vi) design technology, (vii) realm of artifacts, (viii) realm of processes, and (ix) design application. They have identified research domains within each contextual category, dividing design research into branches called operation trajectories.

Identifying the challenges of product development in the current research and comparing them to the very beginning of the dicipline, Beitz [11], it can be noted that the challenges have not changed significantly. Beitz has identified the following challenges:

- Increased complexity of products to meet increasing requirements regarding technical performance and quality;
- Tighter market requirements concerning development time and manufacturing costs;
- Shorter innovation time due to rapidly changing technologies;
- Increased accountability in product development regarding schedule and cost of the product;
- Limited rationalization in product development compared to other departments;
- Required integration of development with manufacturing;
- Increased deployment of computers, also in product development;
- Shortage of designers.

It is obvious that there exist a number of different, yet influential models of design process, which by using a linear sequence of design activities describe or prescribe designing. A common feature of different models of design process is that the process is divided into design stages, which are not necessarily defined in the same manner. On the other hand, we have a national standards (i.e. VDI) prescribing the desired model of design process. For a long period of time there has been a misunderstanding in (at least) two main directions growing and spreading in the community. The first line of misunderstanding is between groups and individuals of design research community where (often) design research has been duplicated or reinvented. The second line of misunderstanding emphasized many times, obviously for its seriousness, stretches across education, research and industry. The primary issue is dissatisfaction with the weak links between the research and education on the one hand and the research and industrial implementation on the other.

Engineering design is a distinguished discipline, but obviously with many dimensions, different classification systems, and machinery. Horvath indicates three aspects of engineering design:

- it synthesizes new information for product realization,
- it establishes quality through defining functionality, materialization and appearance of artifacts,
- it influences the technological, economic and marketing aspects of production.

THE NEED FOR THE DESIGN POLICY

It could be expected that a clear vision of the current state and future goals and directions in a highly unstructured field could be beneficial both for the community and individuals. Such a vision should be called the design policy. The policy of design research community has not yet been outlined.

Such a goal can be a hazardous one. It is often the case that the consequences of “…policy decisions are rarely intended and even more rarely preferred by any one of the actors individually….” (12). Before we explore the matter further, we shall try to explain what we mean as a policy. Policy influences present and future activities of the others. The central question about every policy, including the design policy, would be how we can distinguish unsuccessful policy from unsuccessful implementation? The question is whether we can readily tell when the goals of the policy have been achieved. Additional questions that need an answer are whether we can tailor the design policies to the specific needs, thus making designing more effective, how we can recognize when we need new policies for new circumstances.

The most important feature of a policy is that it implies the authority to cause changes. Such changes inevitably initiate new relations among various functions of product development chain. At the core of the design policy we must recognize two distinct processes that could possibly be proposed: the first would be the design policy development and the second its implementation. Such a dualism is not a unique feature of a design process or product development process, as it occurs in many other domains under different names. In everyday politics the “policy generation process” is differentiated from political events. Control theories, for example, define a policy as “any rule for making decisions that yields an allowable set of actions”. From the operations research viewpoint Keeney describes “fundamental” objectives addressing the central point of a decision and “means” objectives referring to approaches to achieving the fundamental objectives. Each of two named processes results with a different, significant output for the process. The Table 1 illustrates the above line of thought with the examples in different domains.

Table 1 Policy function and implementation outputs

Domain	***Policy Function Output***	***Implementation Function Output***
Business	Business area profit goals	Products and prices
Diplomacy	Political and economic objectives	Negotiations and treaties
Economics	Fiscal objectives	Monetary practice
Engineering	Mission objectives	System design
Medicine	Diagnosis	Treatment
Military	Theaters and objectives	Strategy and tactics
Religion	Dogma and creed	Liturgy
Science	Theories and hypothesis	Analyses and experiments

The problem definition is of a crucial importance for the design process. The same holds for the policy change. A successful design policy function will therefore enable a set of directives (i.e. inputs to the implementation function) that will resolve the discrepancy between the states “as is” and “to be”. More precisely, the design policy directives should establish the goals of the implementation function. A successful implementation function, oriented to the efficiency of the design process, could produce measurable and comparable effects. Inadequate policy or poor implementation will lead to undesirable results. Continuous failure in the implementation function will cause failure in the proposed design policy process, regardless of the quality of the design policy function. It is quite obvious that both aspects of design policy react to the results they cause, revealing the presence and feedback. “Feedback mechanisms … by continually responding to discrepancy between the system’s actual and desired state adapt it to long-range fluctuations in the environment, without forecasting” [8]. The design process is not only engineering or technological phenomenon, it is a cultural and social issue, therefore, as in other social matters, a multiple, nested feedback loops should be expected as a constant events. Each loop provide adjustments on the local state level, but potentially influencing the system level. The feedback (in some terminology referred as evaluation output) is essential for the decision. In order to adjust decisions to unexpected occurrences, improved knowledge and changes is required. A possible bottleneck for the design policy implementation will be inertia, as in any complex system. The responses to initial policy directives could be misleading indication of the final outcome. Further policy can evolve without the policy makers, as in politics the policy makers have one way of imaging it that may not fully correspond to the view of those who carry it.

THE IMPACT OF INFORMATION FLOW

The policy process mainly depends on the information flow accuracy. Inaccurate information flow that is not capable of disseminating to the receiver the appropriate, relevant, up-to-date information will distort the perspective of the decision makers. In the design process the information flow is of particular importance, because most information designers collect in more or less informal ways. For instance March, as reported in [12], has found in a study in Rolls Royce that designers have gained 82% of their information from the people they knew and 9% from the people they did not know. Sources of the remaining 9% of information gathered in March’s report were computers (3%), bookshelves (2%), filing cabinets (2%), desks (1%), and drawing vaults (1%). These results suggest that information flow is not smooth or fail-safe or restricted to formal channels, or even deliberate communication; it is often chaotic and cannot be predicted in all its aspects.

From the policy makers’ viewpoint tracking the information flow in detail through the design process will be both inefficient and unnecessary for guiding the management of design communication. Manifestations of communication breakdown are manifold. In the research presented at ICED 01 [12] manifestations of inadequate information flows have been grouped under three problem headings: misunderstanding of the system as a whole; missing information provision; and information distortion.

The first problem group arises from the fact that product development activities are programmed and coordinated on the higher level then the individuals and teams that are performing actual processes, ‘’…resulting in lack of awareness of interactions between components of designs and between design processes’’. Further insight recognized that team members were not aware of the requirements of other designers and, therefore, failed to do tasks due to the lack of knowledge where items of information, such as specifications and parameter values, come from. Backtracking the information path is especially difficult across organizational barriers. The forward information flow is also unknown, therefore, design team members often do not know who depends on the information that they are creating, nor how they use this information. The lack of awareness of changes to the processes is more dangerous.

The second group of problems arises from the simple fact that designers are not told what they need to know on time. Information is rarely not provided at all. More often the information is provided ‘’naked’’ without context, feedback, status, decision constraints and backtrack reasoning. The simplest but not less dangerous inadequate information flow is withholding the information through the supply chain.

Information distortion is often the result of a long information flow that involves several other people before it reaches the recipient. In the process of transmission, information is oversimplified, distorted by chained misinterpretation due to hierarchical informational paths between organizational units. Such a distortion could be the result of intermediary.

Everything in the design process, as well as in the policy process, depends on the accuracy of perceived information feedback on the policy and implementation functions. Simon observes that “because of the possible destabilizing effects of taking inaccurate predictive data too seriously, sometimes it is advantageous to omit prediction entirely, relying wholly on feedback, unless the quality of prediction is high.” The fact is that all data and information available to policy and decision makers come from observation functions. The data are filtered and “they cannot see the actual state of the affairs”. Even with good information, policy assessment can be misleading due to the fact that policy is rarely defined in explicit formulation. Contemporary management practices manifest such behavior. There is a tendency on the part of top managers to keep many and varied information channels, to focus on a limited number of issues (ignoring the rest) and practice the art of imprecision.

Assuming that policy ends with the “policy function” can not be a sufficient approach because it ignores the “real word” implementation issues. A policy that does not care about the feedback will likely fail to fulfill its objectives.

Any attempt to define a future design policy should:

- demonstrate a differentiation between policy activities according to purpose and the information content;
- define the forward and backward information paths;
- demonstrate a role of policy paradigm as a main policy driver;
- demonstrate the underlying unity devoted to the product development process;
- show resistance to atypical inputs, providing a means to evaluate arbitrary action of the actors.

Therefore, the building brick of the design policy should be the interrelationships between policy and implementation information. The reference viewpoint mechanism is essential tool for the future design policy makers. It should enable an insight into the imposed constraints and acceptability to pre-existing policies.

Design policy process interactions can occur between the policy, implementation and strategy functions across all the elements involved in the product development process. Among the most interesting features of the design policy assessment is that the implementation function and strategy function overlap.

In the end it should be noted that the policy model generates the strategic guidelines for the implementation function. Further, a strategy helps to prioritize the functions and actions guiding in desirable directions.

CONCLUSION

Referring to numerous previous attempts to systematize the field of design science in order to enable a clear vision for the future, we have tried to rethink the complexity from a higher level. An appeal for a new approach by introducing the need for a comprehensive design policy has been argued although the policy of design research community has not yet been outlined. This article proposes a systems description of design policy and the process of its generation and implementation.

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