

# WHAT EVERY DESIGN ENGINEER SHOULD KNOW ABOUT DESIGN RESEARCH

Lecture by:

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Part One

## Increasing the intelligence of designing by design research

There is a heavy competition on the product markets nowadays. To achieve or maintain a leading position, companies are forced to develop globally competitive products. As a result of the market competition and the technological push, both the functional complexity and the quality expectations of products are growing. To take the challenges successfully, the intelligence of designing needs to be increased and the problem solving capability of designers has to be improved. Designers need to process all relevant pieces of information and knowledge in the early phases of the product development process, no matter if they are directly available or not. If the necessary knowledge is not directly available, designers have to consider design research. By using research methods together with engineering design methods, they can achieve high level knowledge-intensiveness in designing and can produce better products. Design research methods help explore, infer, verify and validate design knowledge for a competitive product development.

Research is a human endeavor to discover new knowledge and to collocate existing knowledge by a systematic study and critical investigation into things, phenomena and other concerns. Many elements of this creative process are based on scientific knowledge, but at least as many are non scientific. The part of design research, which can be called foundational research, is to deal with the scientific issues related to design. The main goal is to get insight in and to extend the disciplinary understanding of the phenomenon and principles of design. The part of design research which is dealing with more pragmatic, product related, knowledge issues is called operative design research. On the one hand, the goal of operative design research is to enhance the practical problem solving capacity by a systematic investigation into design processes and by supporting them by proper methods and tools. On the other hand, it is also a goal to construct a multi-disciplinary body of knowledge for innovative solutions and artifact development. All specific topics of design research can be sorted into three generic category: (i) controlled scholarly creation by design, (ii) orderly social embedding of design, and (iii) manifestation of reasonable artifactual systems. Design research can provide descriptive, explanatory and predictive knowledge.

The common knowledge aggregation and exploitation program of design research is based on operative constructivism, which asserts that testable and useful synthetic knowledge can be created by fitting parts of knowledge together on purpose. Actually, design research uncovers how existing knowledge can be incorporated into new concepts, theories, methods and tools. The general process of design research differs from the general process of designing, though some analogies do exist. The research cycle is typically decomposed to six stages. The first stage is concerned with aggregation of initial data or knowledge. The second stage, called induction, involves formulation of research problems and questions, generating research hypotheses, and investigation of research opportunities. The third stage, referred to as deduction, derives specific consequences from the hypotheses, in the form of correct descriptions and explanations, or measurable criteria implied by the hypothesis and concepts. The fourth stage alternatively involves testing of the hypotheses against new empirical materials, deriving testified predictions, and mapping of the concepts into testable realizations, respectively. The objective is to check whether or not the predictions are fulfilled. The fifth stage is verification, with the goal to test the outcome of knowledge exploration and/or construction procedure with respect to the hypotheses, theories or criteria stated, as well as with a view to subsequent, continued, or related validation and utility investigations. Finally, the sixth stage involves the consolidation of research findings, the integration of the new results into the existing body of knowledge, the documentation and dissemination for practical utilization, and the stimulation of related research.