

Interview with Alan R. Hevner on “Design Science”

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BISE: In contrast to the 1990s where occasional articles in major IS journals addressed design research and/or published artifact construction, we recently saw a series of special issues on IS design research in leading journals, a design research track at ICIS, and a new international conference series on IS design research (DESRIST). What are the

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reasons behind this development? Is there a shift in research paradigms or just an emancipation of an overlooked specialty? Do you think that we should expect even more visibility of design research in the future? If yes, what additional outlets and what additional forums are needed?

Hevner: I view the emerging recognition of design research in Information Systems as a natural evolution of our field as it matures. The realm of IS research is at the confluence of people, organizations, technology, and work systems. Information systems and the organizations they support are complex, artificial, and purposefully designed. Much of the work performed by IS practitioners and managers

in general deals with design – the purposeful organization of resources to accomplish a goal. Thus, I feel it is incumbent on IS researchers to better understand the sciences of design and to apply these understandings (e. g. design theories, design processes) to the creation and evaluation of new and useful artifacts.

More and more, researchers and practitioners in the IS field are realizing the value that a design component brings to a research project. Design science offers an effective means of addressing the relevancy gap that has plagued academic research; a concern that has been often identified and debated in the IS literature. While natural science research methods are appropriate for the study of existing and emergent phenomena, they are inadequate for the study of ‘wicked problems’ which require innovative solutions. Such problems are more effectively addressed using design research methods.

Researchers in application domains as disparate as health care, E-commerce, biology, transportation, and the arts identify the key role of designed artifacts in improving domain-specific information systems and work processes. Design researchers bring rigorous design theories and processes into projects that heretofore had not clearly articulated how new ideas become embedded in purposeful artifacts and then how those artifacts are field tested in real-world environments to demonstrate utility.

It will be important to expand the opportunities for design research to be presented and published in top quality IS conferences and journals. I am encouraged by the increased recognition of design research in the community as evidenced by the examples you mention in your question. As a community of IS design researchers, we need to make the most of these opportunities and produce research contributions that are valued as rigorous and relevant to the business community.

BISE: While design oriented IS research has always been strong in many European IS research communities, IS research in the United States and other countries is still dominated by the behavioral paradigm. The co-existence of two research paradigms may be of mutual benefit: On the “building” level, (a) artifact construction and artifact evaluation can partially apply social science methodology and/or partially utilize IS theories, and (b) behavioral IS research can partially utilize rigorously designed artifacts. On the “reflection” level, (c) design science might learn from the rigor standardization in behavioral research and (d) behavioral science might benefit from the embedding of problem/goal orientation of design research. How do you assess these potentials and do you see additional synergies?

Hevner: I believe that the great appeal of performing research in information systems is the opportunity to experience the synergies that come from combining design and behavioral methods. The simple **Fig. 1** illustrates the complementary research cycle in which the results of behavioral research drive innovative design and design research leads to the search for new behavioral theory.

Technology and human behavior are not dichotomous in an information system development and implementation. They are in fact inseparable. They are similarly inseparable in IS research that strives to be both rigorous and relevant. Justified theory (truth) and effective artifacts (utility) are two sides of the same coin. Design must be informed by appropriate theories that explain or predict human behaviors; however, these theories may be insufficient to fully enable the development and adaptation of useful IS artifacts. Thus, there is a need for design research to explore the creative processes of problem solving, goal setting/attainment, and human intentionality in the development and appropriate-

tion of organizational artifacts. I believe that an effective IS researcher should be trained in both behavioral and design research methods and have the ability to bring a full set of research skills to a challenging research project.

I see additional synergies of the design research paradigm with research methods used in fields such as economics and the social sciences. To give one example, I have discussed the economics of design with Dr. Carliss Baldwin of Harvard. She characterizes designs as targets of investment in the economic system. In financial terms, designs are assets. In fact, she argues, designs are a special type of asset; they are options since one may always elect not to use a new design or may have multiple competing designs from which to choose. Thus, economic theories of investments can be applied to designs (options) in order to study and better understand design origins, design decisions, and design dynamics from an economic perspective. As IS design research matures I am confident that synergies with other research paradigms will be discovered and explored.

BISE: The debate among IS design researchers over the “right” design research process model is ongoing. Most Colleagues agree that there should be a rigor cycle, a relevance cycle, and a design cycle. But not only Ph.D. students are still unsure about commonly accepted standards in the IS design community for the rigor of artifact construction and in particular for the rigor of artifact evaluation. Where do you think the community stands today, and where should it be aiming at?

Hevner: Rigor in design research is what separates a research project from the practice of routine design. However, we need to be careful to identify the sources and types of rigor appropriate for design research. The risk comes when experts in other research paradigms attempt to apply their standards of rigor to design research projects in which creative inspiration or gut instinct may lead to design decisions. To insist that all design decisions and design processes be based on grounded behavioral or mathematical theories may not be appropriate for a truly cutting-edge design artifact. Such theories may as yet be undiscovered or incomplete and the research activities of design and evaluation of the artifact may advance the development and study of such theories.

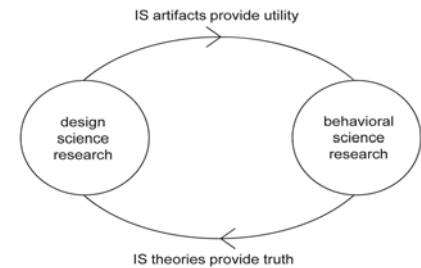


Fig. 1 Complementary research cycle of design and behavioral science research

Consideration of rigor in design research is based on the researcher’s skilled selection and application of the appropriate theories and methods for constructing and evaluating the artifact. Design science research is grounded on existing ideas drawn from the domain knowledge base. Inspiration for creative design activity can be drawn from many different sources to include rich opportunities/problems from the application environment, existing artifacts, analogies/metaphors, and theories. Additions to the knowledge base as results of design research will include any additions or extensions to the original theories and methods made during the research, the new artifacts (design products and processes), and all experiences gained from performing the iterative design cycles and field testing the artifact in the application environment. It is imperative that a design research project makes a compelling case for its rigorous bases and contributions lest the research be dismissed as a case of routine design. Definitive research contributions to the knowledge base are essential to selling the research to an academic audience just as useful contributions to the environment are the key selling points to a practitioner audience.

BISE: Another controversial issue in IS design research is the scope of “the artifact”. Most IS researchers agree that information systems are comprised of human as well as software components. As a consequence, IS artifacts may range from “pure” software systems (without any human component) to “pure” organizational systems (without any software component) – and everything in between. The computer science background of many design researchers drives IS design research into an IT artifact orientation. An indicator are the three DESRIST proceedings which exhibit a clear dominance of software systems and algorithms over “work system” type instantiations or “guideline”

type methods, respectively. Do you see the future of design research more on the IT artifact side or more on the organizational artifact side?

Hevner: Looking at my crystal ball, I see design research growing rapidly in both software systems/information technology and in organization structures and work systems. In my recent two-year assignment at the U.S. National Science Foundation (NSF) I worked on research programs in the Computer and Information Science and Engineering directorate. This is the source of most external funding for the U.S. computer science and software engineering communities for which design research is the dominant research paradigm. It was tremendously exciting to see the enthusiasm of researchers for meeting the challenges of building the next generation of complex software-intensive systems. I was a program manager for research programs in Science of Design for Software-Intensive Systems, Software for Real-World Systems, and Creative IT. It will be important for IT artifact design researchers in the IS field to be more familiar with external funding opportunities from both government and industrial sources. Perhaps more important than the money, such external funding lends a level of credibility to the research and provides networking opportunities with other funded researchers in the same area. My experiences at NSF assure me of the endless opportunities for design research on innovative IT artifacts.

The application of design research to organization structures and work systems has clearly lagged design research on IT artifacts. However, I believe the opportunities for significant design contributions in this field are just as great. Recent call-for-action papers by respected management researchers such as Jean van Aken and William Starbuck along with a 2008 special issue of *Organization Science* on “Organization Studies as a Science for Design: Creating Collaborative Artifacts and Research,” demonstrate the growing importance of design in an organizational context. A key difference in organizational design is that artifacts are typically social structures that depend on human behavior for their usefulness and effectiveness. For example, organization artifacts may include reporting structures, business process standards and rules, agreements/contracts, and award/incentive struc-

tures. Thus, design research methods for constructing and evaluating organization artifacts may require different skills to insure the rigor and relevance of the research project.

BISE: In my understanding, behavioral IS research applies social science methodology to build and validate theories in order to understand IS related phenomena, while IS design research applies “engineering” methodology to build and evaluate artifacts in order to solve IS related problems. While it is clear what “fundamental”/“basic” research is necessary for theory building, the scientific foundation of design research (“design science”) seems to be still emerging. There are many proposals that design science should draw from (mechanical/ electrical/ civil) engineering, computer science, design, organizational theory, and others. What sources are most important from your point of view, and how can these heterogeneous sources be integrated into a sound scientific foundation for IS artifact design?

Hevner: During the 2008 Design Science Research Conference in Information Systems and Technology (DESRIST), I participated in the first Doctoral Consortium as a faculty mentor. Eleven doctoral students from Europe and North America and seven faculty mentors engaged in a full-day of discussions on what constitutes high quality design research, what are the foundations of design research, and how do we prepare the next generation of design researchers? The interdisciplinary makeup of the group included researchers in the fields of Information Systems, Software Engineering, Computer Science, Production and Management, Environmental Design, Learning Sciences, and Informatics. (A report on the doctoral consortium to include a summary of the discussions is in preparation.)

Relating to your question, in the doctoral consortium we discussed an important dichotomy found in design sciences that ties directly to different research foundations. ‘Design as Research’ highlights the actual performance of innovative design in a specific application domain as a research project. This type of research is typically what we characterize as design research in the IS field. It draws its scientific foundations from mathematical sciences, engineering, and natural sciences as discussed above in my discussion on rigor. An important observation is that

this type of research also requires extensive domain knowledge for the environment in which the design artifact is to be deployed. One or more members of the research team must be domain experts and be able to draw from the foundations of that application area.

The second type of research can be titled ‘Researching Design’. The foci here are studies of designs, design patterns, design processes, metrics of good design, design creativity, and other aspects of the general design activity. A goal is to generate a domain-independent understanding of design that can be applied to any design project. Research in this stream draws from and builds on scientific foundations in cognitive psychology, group dynamics, and social sciences. An interesting hybrid of these two types of design research would be a research project on the design and construction of IT tools to support design creativity.

Thus, to answer your question, I believe that the many varieties of design science research require a wide range of scientific foundations. A specific research project will determine the mix of research skills and domain knowledge needed for success. The design science research paradigm can be applied so widely to so many challenging design problems that it does not lend itself to an easily circumscribed set of scientific foundations.

BISE: I know that you are aware of the 50 year history of the WIRTSCHAFTSINFORMATIK journal, you have published in WIRTSCHAFTSINFORMATIK and often visited the German-speaking countries for keynotes and conferences. WIRTSCHAFTSINFORMATIK is the only non-English-language IS research journal to be “A” rated in many countries. This no 1/2009 issue is the first bilingual edition – WIRTSCHAFTSINFORMATIK in German and in parallel “Business & Information Systems Engineering” in English language. Many – if not all – other “A” rated IS research journals have adopted behavioral research as their reference paradigm. Is it too dangerous to establish an “engineering” focus for an “A” rated journal, i.e. to clearly position it as an outlet for IS design research? What are your recommendations for such a journal? How should we effectively establish “Business & Information Systems Engineering” in the global IS research community?

Hevner: First, let me congratulate the editorial board and publishers of

WIRTSCHAFTSINFORMATIK for extending the reach of the journal into the English speaking research community via Business & Information Systems Engineering (BISE). I believe that there is an unmet demand for journal outlets that welcome the submission of information system design research papers. Throughout my academic career, I published the majority of my design research papers in journals sponsored by ACM and IEEE Computer Society, the two premier computer science professional organizations. However, I believe the time is opportune for the IS community to provide such outlets for design researchers.

In my role as Senior Editor of MIS Quarterly, I am working to encourage the submission of the best design science research papers to that journal and I know that other

well-recognized IS journals are opening their doors wider to design research. BISE, however, has some unique advantages for positioning itself as a desirable outlet for design science research. These advantages include a long, distinguished history of service to the European IS community, a high ranking with citation services such as Thomson ISI, and an internationally recognized editorial board. The challenges BISE will face to become a journal of first choice for design researchers include becoming more visible to the international IS community, making the journal more widely available to researchers, perhaps through an arrangement with the Association for Information Systems (AIS), and identifying itself with cutting edge research topics of importance to design researchers. On the final point, the appearance of special issues

on hot topics, possibly in connection with highly visible conferences, might provide a jump start of interest in the journal. Also of vital importance to academic researchers is the appearance of BISE as an A journal in journal rankings. This will take some marketing of the journal's quality to key constituencies who define and use journal rankings.

In conclusion, thank you for the opportunity to be part of first issue of Business & Information Systems Engineering. I am confident that this new endeavor will continue the distinguished heritage of WIRTSCHAFTSINFORMATIK and will become a highly valued outlet for design research in the IS field.

BISE: Thank you very much for this interview.