

## EDITOR'S COMMENTS

### Design Science Research in Top Information Systems Journals

By: **Paulo B. Goes**  
**Editor-in-Chief, *MIS Quarterly***  
**Salter Professor of Technology and Management**  
**Head, Management Information Systems**  
**Eller College of Management**  
**University of Arizona**  
**pgoes@eller.arizona.edu**

Since the emergence of the IS field in the 1970s, advancing knowledge about the *design, creation, and development* of information systems or IT artifacts has been an important stream of IS research. This research has, throughout the years, been referred to as technical, systems-oriented IS research. Iivari (1993) coined the word “systemeering,” while Nunamaker et al. (1990) used the terms “systems development” or “engineering approach” to describe these research efforts. Many research groups doing technical IS research thrived in business and information schools in the United States at institutions such as MIT, Carnegie-Mellon, Arizona, Wharton, Rochester, Georgia State, New York University, Purdue, Texas at Austin, and Texas at Dallas, among many others.

In 1990, there was a defining moment in the recognition and organization of the technical and systems orientation of IS research. WITS, the Workshop of Information Technology and Systems, was established as a pre-ICIS workshop. The first event was hosted on the campus of MIT in Boston and took place Saturday and Sunday before the start of ICIS, which was held in New York City that year.

WITS provided a forum and an identity to technical/systems IS researchers. Throughout the years that followed, the workshop format created a stimulating environment for advancing research in important IS topics such as decision support systems, collaboration systems, information quality, conceptual modeling, analytical modeling, optimization, etc. As a workshop, WITS continues to be the destination of choice of established researchers and graduate students in the technical IS areas, attracting over 150 attendees annually.

While WITS provided a platform for advancing knowledge in the technical IS area, the path for top tier publications of technical IS research presented challenges. Due to the computer science and engineering connections at the reference disciplines level, top tier outlets in these fields have been the outlets of choice for top technical research: ACM and IEEE journals and transactions, as well as *Decision Support Systems* and *INFORMS Journal on Computing*.

#### ***The Design Science Paradigm***

In 2004, the paper “Design Science in Information Systems Research,” coauthored by some of the most active and prominent members of the WITS community (Al Hevner, Sal March, Sudha Ram) was published in *MIS Quarterly*. Since its publication, the paper has received enormous attention; it is currently the 4<sup>th</sup> most-highly cited article ever published in MISQ (<http://www.misq.org/skin/frontend/default/misq/pdf/MISQStats/MostCitedArticles2013.pdf>).

The Hevner et al. (2004) article has had a tremendous impact on IS research. With its roots in the seminal work by Herbert Simon (1996), *The Sciences of the Artificial*, it has consolidated the technical/systems streams into the well-articulated design science paradigm—a problem solving paradigm. The authors elaborate on the broad definition of the IT artifact, one that encompasses constructs, models, methods, and instantiations, matching the main sub-streams of the WITS community. With its appearance in the premier IS journal, it provided top tier publication legitimacy to a stream that was used to going outside IS outlets to publish its best research.

One of the main points of the Hevner et al. paper is to contrast the design science paradigm with the behavioral sciences paradigm. While the latter is concerned with explaining and “truth finding,” it is reactive in the sense that the information systems or IT artifact is given. On the other hand, the design science paradigm is proactive, it seeks problem solving, creation and innovation. It is about evaluating and determining the utility of technology and IT-based systems. The paper articulates how the two paradigms are complementary and interdependent.

### ***Design Science in MIS Quarterly***

Following the 2004 design science article, there was a Special Issue on Design Science in MISQ, which published five articles in 2008. After that, senior and associate editors representing the design science community have been part of the board.

With 10 years elapsed since the 2004 article, it is a good time to evaluate the presence of design science articles in the journal. From November 21, 2012, to November 20, 2013, there were 17 submissions that were deemed “design science” submissions and that were handled by design science editors. In the same period, without counting submissions to special issues and desk rejections by the Editor-in-Chief, there were a total of 346 new submissions handled by the journal. Less than 5 percent of all new submissions to MISQ reflect design science work!

In their recent and excellent research essay, Gregor and Hevner (2013), study all design science papers published by MISQ in the period 2006–2011, which includes the five articles in the special issue. A total of 13 publications were identified during that period.

Design science submissions account for less than 5 percent of the overall submissions to MISQ last year and the total number of design science publications in MISQ since 2006 accounts for less than 5 percent of the total publications in the journal. The natural question to ask is why isn't a journal like MISQ attracting and publishing more design science work? I will argue later that design and the application of the design science problem-solving paradigm is becoming more important, not less!

### ***Design Science: Difficult Path to Publication***

Two interrelated, plausible explanations for the general absence of design science work in a top journal such as MISQ come to mind:

- (1) Despite its stated openness to design science work, the general editorial culture of MISQ hasn't changed much. It is still one that evaluates contribution to knowledge through the lens of social science research paradigms. The general perception is that MISQ (and other top IS journals) expects a clear tie to theory and possibly convincing theoretical contribution from research articles.
- (2) Gregor and Hevner (2013) also point out that there is still “ongoing confusion and misunderstanding of [design science research's] central ideas and goals” (p. 338). This is reflected in the fact that authors, reviewers, and editors struggle to understand and follow a well-understood formula for writing and reviewing design science articles.

Early design science submissions may have encountered editorial culture inertia and may have been mishandled by the application of misguided evaluation criteria by reviewers and editors. I personally know of various cases where manuscripts encountered resistance in the review process due to “lack of theory” or “weak theory development.” These experiences could have hampered the enthusiasm of design science researchers about pursuing a journal like MISQ.

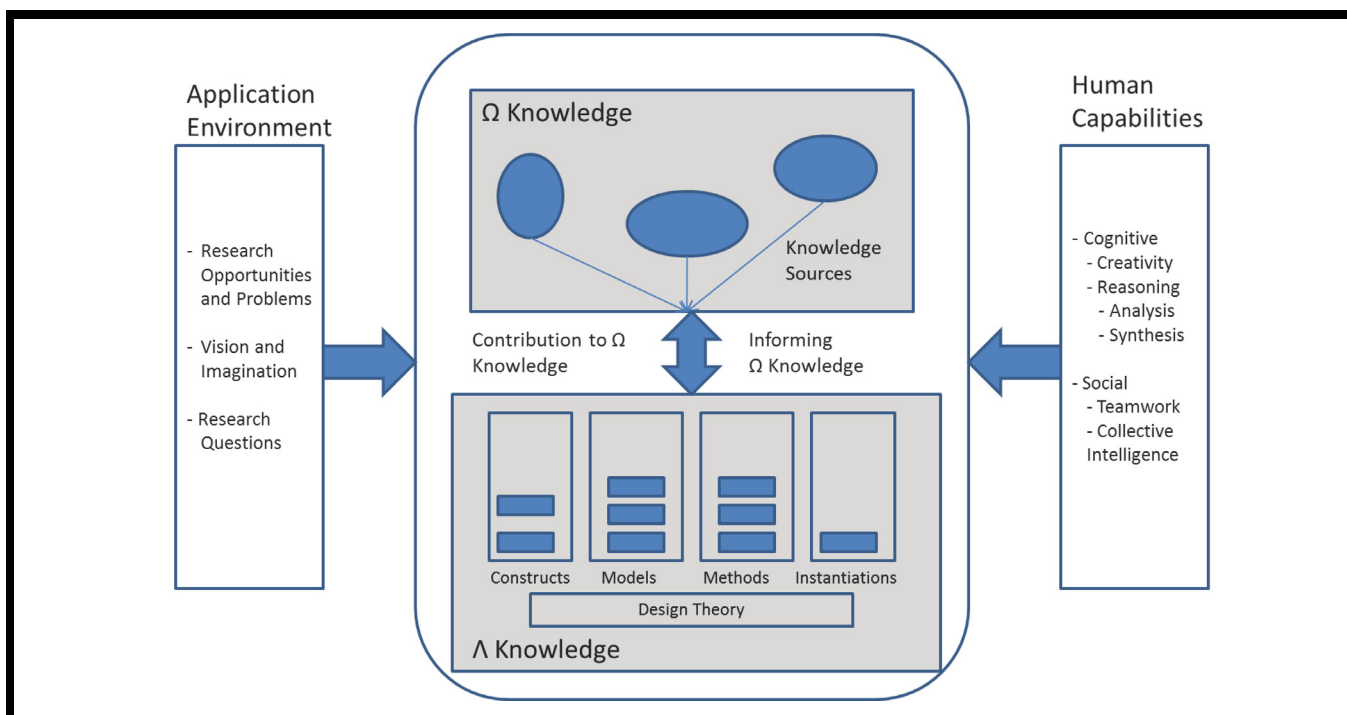
Let us examine what is expected to be a contribution to knowledge and a tie to theory in design science research. The research paradigm is about *problem solving*; it is about presenting solutions through systems and IT artifacts, broadly defined as constructs, models, methods, and instantiations. By examining the maturity of the problem domain and the maturity of the solutions space, Table 1, adapted from Gregor and Hevner, presents a framework for evaluating the knowledge and research contribution of a design science work.

**Table 1. Design Science Contributions to Knowledge: Problem-Solution Space**

Problem Domain Maturity	Solution Maturity	Knowledge Contribution	Publication Opportunity in MISQ
Known Problems	Known solutions	Routine design None to research	No
Known Problems	New solutions	"Improvement" Research contribution	Yes
New Problems	Adopted solutions from other domains	"Exaptation" Research contribution	Yes
New Problems	New solutions	"Innovation" Research contribution	Yes

Using this solution-to-problem framework helps us understand that contributions to knowledge (i.e., research) lie in exploring the novelty of the problems and the novelty of the solutions. See Gregor and Hevner for research exemplars that were published in MISQ. Most of that work comes from the improvement category, where new solutions to known problems are proposed.

To understand the nature of the connection to theories in design science research, let us look at Figure 1.

**Figure 1. The Roles of Knowledge in Design Science Research (Figure 1 in Gregor and Hevner 2013)**

A design science artifact is created against the background of the descriptive knowledge  $\Omega$  about the problem domain (artificial, natural, human) and its laws, regularities, principles, and theories. The artifact itself encompasses and produces knowledge  $\Lambda$  as constructs, models, methods, and instantiations that may or may not lead to the level of abstraction that constitutes a design theory.

The artifact, its deployment and analyses can in turn contribute back to the descriptive knowledge and/or create new knowledge of its own. In design science research, the main concern is not to test or create new theories, although the constructs and methods

that are created can lead to these. Rather, the main objective is to create knowledge through meaningful solutions that survive rigorous validations through proof of concept, proof of use, and proof of value. Therefore, it is absolutely not a requirement of successful design science manuscripts to have an explicit tie to theory. This misconception should be avoided.

Does it mean that an article without an explicit tie to theory is less rigorous? Absolutely not. The rigor in design science research must be pursued in the methods employed in the development of the artifact and the methods employed in the validation of the artifact/solution.

As opposed to the general anatomy of a positivist social science based research manuscript, which makes the theory the starting point, a design science manuscript follows the general recipe or publication schema as follows (Gregor and Hevner 2013):

- (1) Introduction with precise articulation of purpose and scope of the artifact.
- (2) Literature review section with relevant descriptive knowledge and prior prescriptive knowledge. Notice that this section may not refer to any theories if the descriptive and prescriptive knowledge bases do not include them. Or the theory tie may be presented in a circumstantial fashion, since the purpose of the article is not theory testing.
- (3) Method section where research rigor is fundamental.
- (4) Artifact description.
- (5) Evaluation.
- (6) Discussion and conclusions.

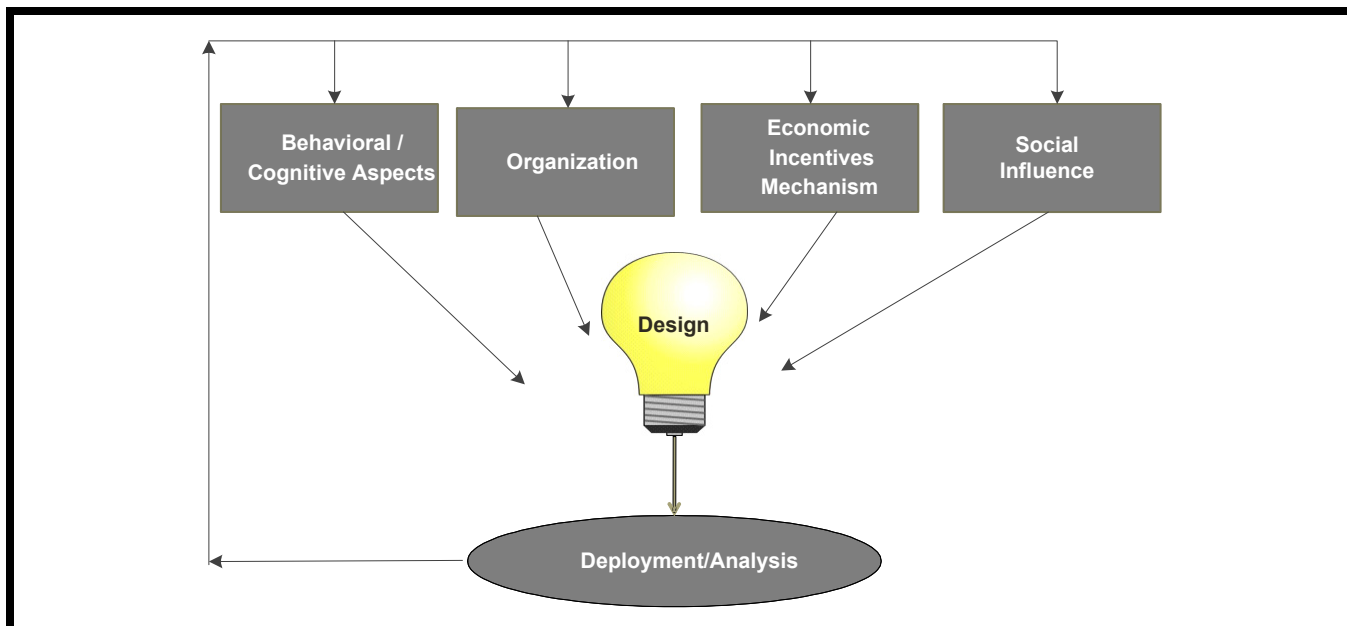
### ***The IS Field Needs More Design Science Research***

Ironically, while design science research has not gained much publication traction in a journal such as MISQ, I subscribe to the notion that the field needs more design science research. Not only design is what drives innovations, but design science is the unique paradigm that can tie all the other IS paradigms together. The reality of our field is that waves of technology innovations keep coming. The exponential nature of change derived from the various forms of Moore's law tells us that the rate of change is accelerating, and we can feel the effects through the wide digitization of society and economies, "sensorization" of people, high instrumentation of everything (Internet of things, sensors), explicit and implicit networks of interactions, and analytics applications, just to name a few trends. It is the age of smart everything, the age of social everything, the age of crowds and communities of different types, the age of the quantified self, the age of games, etc. Design science is at the center of innovation creation and solution building.

More and more, a participant in the IT-enabled and IT-surrounded environment is at the same time an economic agent, a social player, may be part of an organization, with his/her behavior defined by cognitive skills. As seen in Figure 2, design of IT applications now draws from the knowledge set  $\Omega$  that is fast expanding into areas that tie all IS streams together: cognitive and behavioral knowledge, organization science, economics, and social sciences.

The reach of the new technological environments also allows for very exciting ways to validate the design of the artifacts. These relate to actual deployment of the IT solutions and the utilization of randomized field experiments for validation. We now have access to tools that enable us to go from a controlled proof-of-concept to a more generalized proof-of-use and proof-of-value. Some exciting recent work that leverages deployment and larger-scale field experimental validation can be seen in the following exemplars:

- Design of a crowdsourcing system for scientific observation (Parsons et al. 2011)
- Interface design of video on demand system (Matos et al. 2013)
- Design of anonymity features in an online dating system (Bapna et al. 2013)
- Design of a deception detection automated kiosk for homeland security screening (Nunamaker et al. 2011)



**Figure 2. Expanding the Descriptive Knowledge Set  $\Omega$**

### Call for Action

Design of systems, solutions, and artifacts has always been a fundamental component of IS research. Given the fast pace of technological changes we are experiencing at this juncture of the information revolution, the importance of design science has to be at the center of IS research. While design science research is widely recognized as one of the main paradigms of IS research, it has not experienced much publication success in a journal like MISQ. The main reason is that design science researchers are not submitting their work to the top tier journals in the IS discipline. The preferred publication path continues to be top journals in the reference disciplines of computer science and engineering.

Despite recent efforts to open up MISQ to design science, there still exists a perception disconnect between what constitutes contribution to knowledge of a design Science manuscript versus contribution to knowledge by IS research that follows a social science paradigm. The recent paper by Gregor and Hevner (2013) sheds light on this issue and presents a clear anatomy of design science for IS that should be followed by authors, reviewers, and editors.

It is imperative that papers in design science be judged by appropriate criteria, and yet provide tangible contribution to knowledge. I expect MISQ editors and reviewers to fully understand and apply the criteria. Our field needs rigorous design science work that provides intradisciplinary contributions and advances our understanding of the new domains and applications. Let's solve all those interesting problems out there.

### References

- Bapna, R., Ramaprasad, J., Shmueli, G., and Umyarov, A. 2013. "One Way Mirrors in Online Dating: Evidence from a Randomized Field Experiment," Working Paper, University of Minnesota
- Gregor, S., and Hevner, A. R. 2013. "Positioning and Presenting Design Science Research for Maximum Impact," *MIS Quarterly* (37:2), pp. 337-355.
- Hevner, A. R., March, S. T., Park, J., and Ram, S. 2004. "Design Science in Information Systems Research," *MIS Quarterly* (28:1), pp. 75-105.
- Iivari, J. 1983. *Contributions to the Theoretical Foundations of Systemeering Research and the PICOCO Model*, Oulu, Finland: Institute of Data Processing Science, University of Oulu.

- Nunamaker, J., Chen, M., and Purdin, T. 1990-1991. "Systems Development in Information Systems Research," *Journal of Management Information Systems* (7:3), pp. 89-106.
- Nunamaker, J., Derrick, D., Elkins, A., Burgoon, J., and Patton, M. 2011. "Embodied Conversational Agent-Based Kiosk for Automated Interviewing," *Journal of Management Information Systems* (28:1), pp. 17-48.
- Matos, M., Ferreira, P., Smith M., and Telang, R. 2013. "The Impact of Likes on the Sales of Movies in Video-on-Demand: A Randomized Experiment," paper presented at WITS 2013 (Workshop on Information Technology and Systems), Milan, Italy, December 2013.
- Parsons, J., Lukyanenko, R., and Wiersma, Y. 2011. "Easier Citizen Science is Better," *Nature* (471:7336), p. 37.
- Simon, H. 1996. *The Sciences of the Artificial* (3<sup>rd</sup> ed.), Cambridge, MA: MIT Press.