Design Science

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Design science is a research paradigm centered on the creation of innovative, first-of-a-kind information systems artifacts. Researchers in design science are still exploring developing the methodological foundations of design science.

For a long time, I have been adopting design science as the paradigm of choice for supervising doctoral and master research projects [1]–[4]. Design science allows doctoral and master students to focus on stimulating real-world problems, conducting rigorous exploratory and action-oriented research actions, and engendering multiple opportunities for communicating their research in top publications.

Nevertheless, the complexity associated to conducting and communicating about design science research can also be daunting for doctoral and master students, usually faced with the competing challenges of coming up with an innovation and demonstrating research rigor and relevance. Based on my experience supervising doctoral and master students, I have been investigating the methodological foundations of design science, seeking to decrease the overall complexity of conducting and communicating about design science studies.

My first concern was a recurrent difficulty regarding how to formulate research questions for a design science project. As design science is significantly different from other research paradigms, the construction of research questions is also significantly different. Based on an extensive review of design science publications, including research papers and PhD thesis, I developed a typology which defines three main categories of design science research questions: way of knowing, way of framing, and way of designing [5].

Based on a variety of design science projects driven by conceptual frameworks, I have also focused on the nature and purpose of conceptual frameworks in design science research. I reviewed a set of conceptual frameworks used in design science publications and classified them using the set of dimensions mentioned above: way of knowing, way of framing, and way of designing [6]. This study highlights the diversity of roles that conceptual frameworks can take in supporting design science research, and helps researchers develop design science conceptual frameworks.

Recognizing that not only conceptual frameworks but also other types of visual artifacts were commonly used in design science, another study was conducted to analyze the nature and purpose of visual artifacts in design science [7]. The study uses semiotics and a theory of visualization of thought, in combination with a literature review, to elaborate a framework of design science visual artifacts. The study identifies a set of properties that researchers should consider when creating and using visual artifacts in design science: transparency of the relationship between representation and object, self-sufficiency of the visual artifact, and consistency of communication.

I have also been experimenting the adoption of design science in teaching and teaching design science in a variety of domains, including engineering, sciences, business studies, and arts. An article on design science education in undergraduate courses summarizes those experiences [8].

References

[1] C. Sapateiro, P. Antunes, D. Johnstone, and J. Pino, 'Gathering big data for teamwork evaluation with microworlds', *Cluster Computing*, vol. 20, no. 2, pp. 1637–1659, 2016, doi: 10.1007/s10586-016-0715-1.

[2] N. Thuan, 'Establishing Crowdsourcing as an Organisational Business Process: A Design Science Approach', Victoria University of Wellington, 2016.

[3] N. Thuan, P. Antunes, and D. Johnstone, 'A Decision Tool for Business Process Crowdsourcing: Ontology, Design, and Evaluation', *Group Decision and Negotiation*, vol. 27, no. 2, pp. 285–312, 2018, doi: 10.1007/s10726-018-9557-y.

[4] I. Enwereuzo, P. Antunes, D. Johnstone, and G. de Vreede, 'Design and Development of a DSS Supporting the Integration of Crowdsourcing in Theory Testing: A Design Science Perspective', Xi'an, China, 2019. doi: https://aisel.aisnet.org/pacis2019/172.

[5] N. Thuan, A. Drechsler, and P. Antunes, 'Construction of Design Science Research Questions', *Communications of the Association for Information Systems*, vol. 44, 2019, doi: 10.17705/1CAIS.04420.

[6] P. Antunes, N. Thuan, and D. Johnstone, 'Nature and Purpose of Conceptual Frameworks in Design Science', *Scandinavian Journal of Information Systems*, vol. 33, no. 2, 2021, doi: https://aisel.aisnet.org/sjis/vol33/iss2/2.

[7] P. Antunes, N. Thuan, and D. Johnstone, 'Nature and Purpose of Visual Artifacts in Design Science Research', *Information Systems and e-Business Management*, 2022, doi: 10.1007/s10257-022-00559-2.

[8] N. Thuan and P. Antunes, 'Positioning Design Science as an Educational Tool for Innovation and Problem Solving', *Communications of the Association for Information Systems*, 2022.