

Design science (methodology)

Design science is an outcome based information technology research methodology, which offers specific guidelines for evaluation and iteration within research projects.

Design science research focuses on the development and performance of (designed) artifacts with the explicit intention of improving the functional performance of the artifact. Design science research is typically applied to categories of artifacts including algorithms, human/computer interfaces, design methodologies (including process models) and languages. Its application is most notable in the Engineering and Computer Science disciplines, though is not restricted to these and can be found in many disciplines and fields.^{[1][2]} In **design science research**, or **constructive research**,^[3] as opposed to explanatory science research, academic research objectives are of a more pragmatic nature. Research in these disciplines can be seen as a quest for understanding and improving human performance.^[4] Such renowned research institutions as MIT's Media Lab, Stanford's Centre for Design Research, Carnegie-Mellon's Software Engineering Institute, Xerox's PARC and Brunel's Organization and System Design Centre use the Design Science Research approach.^[1]

Contents

Objectives

Evolution

Characteristics

Guidelines in information systems research

Artifacts

A three-cycle view

Ethical issues

See also

References

Research examples

Further reading

External links

Objectives

According to Van Aken, the main goal of design science research is to develop knowledge that the professionals of the discipline in question can use to design solutions for their field problems. This mission can be compared to the one of the ‘explanatory sciences’, like the natural sciences and sociology, which is to develop knowledge to describe, explain and predict.^[4] Hevner states that the main purpose of design science research is achieving knowledge and understanding of a problem domain by building and application of a designed artifact.^[5]

Evolution

Since the first days of computer science, computer scientists have been doing design science research without naming it. They have developed new architectures for computers, new programming languages, new compilers, new algorithms, new data and file structures, new data models, new database management systems, and so on. Much of the early research was focused on systems development approaches and methods. The dominant research philosophy has been to develop cumulative, theory-based research to be able to make prescriptions. It seems that this ‘theory-with-practical-implications’ research strategy has seriously failed to produce results that are of real interest in practice. This failure led to search practical research methods such as design science research.^[6]

Characteristics

The design process is a sequence of expert activities that produces an innovative product.^[7] The artifact enables the researcher to get a better grasp of the problem; the re-evaluation of the problem improves the quality of the design process and so on. This build-and-evaluate loop is typically iterated a number of times before the final design artifact is generated.^[8] In design science research, the focus is on the so-called field-tested and grounded technological rule as a possible product of Mode 2 research with the potential to improve the relevance of academic research in management. Mode 1 knowledge production is purely academic and mono-disciplinary, while Mode 2 is multidisciplinary and aims at solving complex and relevant field problems.^[4]

Guidelines in information systems research

Hevner et al. have presented a set of guidelines for design science research within the discipline of Information Systems.^[5] Design science research requires the creation of an innovative, purposeful artifact for a special problem domain. The artifact must be evaluated in order to ensure its utility for the specified problem. In order to form a novel research contribution, the artifact must either solve a problem that has not yet been solved, or provide a more effective solution. Both the construction and evaluation of the artifact must be done rigorously, and the results of the research presented effectively both to technology-oriented and management-oriented audiences.

Hevner counts 7 guidelines for a design science research:^[5]

1. **Design as an artifact:** Design-science research must produce a viable artifact in the form of a construct, a model, a method, or an instantiation.
2. **Problem relevance:** The objective of design-science research is to develop technology-based solutions to important and relevant business problems.
3. **Design evaluation:** The utility, quality, and efficacy of a design artifact must be rigorously demonstrated via well-executed evaluation methods.
4. **Research contributions:** Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.
5. **Research rigor:** Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artifact.
6. **Design as a search process:** The search for an effective artifact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
7. **Communication of research:** Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Artifacts

Artifacts within DSR are perceived to be knowledge containing. This knowledge ranges from the design logic, construction methods and tool to assumptions about the context in which the artifact is intended to function (Gregor, 2002).

The creation and evaluation of artifacts thus forms an important part in the DSR process which was described by Hevner et al., (2004) and supported by March and Storey (2008) as revolving around “build and evaluate”.

DSR artifacts can broadly include: models, methods, constructs, instantiations and design theories (March & Smith, 1995; Gregor 2002; March & Storey, 2008, Gregor and Hevner 2013), social innovations, new or previously unknown properties of technical/social/informational resources (March, Storey, 2008), new explanatory theories, new design and developments models and implementation processes or methods (Ellis & Levy 2010).

A three-cycle view

Design science research can be seen as an embodiment of three closely related cycles of activities.^[9] The relevance cycle initiates design science research with an application context that not only provides the requirements for the research as inputs but also defines acceptance criteria for the ultimate evaluation of the research results. The rigor cycle provides past knowledge to the research project to ensure its innovation. It is incumbent upon the researchers to thoroughly research and reference the knowledge base in order to guarantee that the designs produced are research contributions and not routine designs based upon the application of well-known processes. The central design cycle iterates between the core activities of building and evaluating the design artifacts and processes of the research.

Ethical issues

Design science research in itself implies an ethical change from describing and explaining of the existing world to shaping it. One can question the values of IS research, i.e. whose values and what values dominate it, emphasizing that research may openly or latently serve the interests of particular dominant groups. The interests served may be those of the host organization as perceived by its top management, those of IS users, those of IS professionals or potentially those of other stakeholder groups in society.^[6]

See also

- Constructive research
- Empirical research
- Action research
- Participant observation
- Case study

References

1. Vaishnavi, V., Kuechler, W., and Petter, S. (2004/19). “Design Science Research in Information Systems” January 20, 2004; last updated June 30, 2019. URL: <http://desrist.org/design-research-in-information-systems>
2. Kuechler B, Vaishnavi V (2008). "On theory development in design science research: Anatomy of a research project". *European Journal of Information Systems*. **17** (5): 489–504. doi:10.1057/ejis.2008.40 (<https://doi.org/10.1057%2Fejis.2008.40>). S2CID 16297257 (<https://api.semanticscholar.org/CorpusID:16297257>).

3. Dresch, Aline; Lacerda, Daniel Pacheco; Jr, José Antônio Valle Antunes (2015). *Design Science Research: A Method for Science and Technology Advancement*. Cham: Springer. pp. i. doi:10.1007/978-3-319-07374-3 (<https://doi.org/10.1007%2F978-3-319-07374-3>). ISBN 978-3-319-07373-6.
4. Van Aken JE (2005). "Management research as a design science: Articulating the research products of mode 2 knowledge production in management". *Br J Manag.* **16** (1): 19–36. doi:10.1111/j.1467-8551.2005.00437.x (<https://doi.org/10.1111%2Fj.1467-8551.2005.00437.x>).
5. Hevner, A. R.; March, S. T.; Park, J. & Ram, S. Design Science in Information Systems Research. *MIS Quarterly*, 2004, 28, 75-106. URL: <http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.103.1725&rep=rep1&type=pdf>
6. Iivari J (2007). "A paradigmatic analysis of information systems as a design science". *Scandinavian Journal of Information Systems.* **19** (2): 39.
7. Watts S; Shankaranarayanan G & Even A (2009). "Data quality assessment in context: A cognitive perspective". *Decis Support Syst.* **48** (1): 202–211. doi:10.1016/j.dss.2009.07.012 (<https://doi.org/10.1016%2Fj.dss.2009.07.012>).
8. Markus ML; Majchrzak A & Gasser L. "A design theory for systems that support emergent knowledge processes". *MIS Quarterly.* **2002**: 179–212.
9. Hevner AR (2007). "The three cycle view of design science research". *Scandinavian Journal of Information Systems.* **19** (2): 87.

Research examples

- Adams, R., Hobbs, V., Mann, G., (2013). The Advanced Data Acquisition Model (ADAM): A process model for digital forensic practice. URL: <http://researchrepository.murdoch.edu.au/id/eprint/14422/2/02Whole.pdf>

Further reading

- March, S. T., Smith, G. F., (1995). Design and natural science research on information technology. *Decision Support Systems*, 15(4), pp. 251–266.
- March, S. T., Storey, V. C., (2008). Design Science in the Information Systems Discipline: An introduction to the special issue on design science research, *MIS Quarterly*, Vol. 32(4), pp. 725–730.
- Mettler T, Eurich M, Winter R (2014). "On the Use of Experiments in Design Science Research: A Proposition of an Evaluation Framework" (<http://aisel.aisnet.org/cais/vol34/iss1/10>). *Communications of the AIS.* **34** (1): 223–240.
- Opdenakker, Raymond en Carin Cuijpers (2019), 'Effective Virtual Project Teams: A Design Science Approach to Building a Strategic Momentum', Springer Verlag.
- Van Aken, J. E. (2004). Management Research Based on the Paradigm of the Design Sciences: The Quest for Field-Tested and Grounded Technological Rules. *Journal of Management Studies*, 41(2), 219–246.
- Watts S, Shankaranarayanan G., Even A. Data quality assessment in context: A cognitive perspective. *Decis Support Syst.* 2009;48(1):202-211.

External links

- [Design Science Research in Information System and Technology \(http://desrist.org/\)](http://desrist.org/) community

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