

# Design science research in information systems

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Wednesday 9:15 - 12:00  
Room 145 (Internef)

## 1 Course Description

The course develops skills needed for conducting design research in information systems. This kind of research aims at designing artefacts such as tools, methods and techniques, that make information systems more effective and efficient. Students will also acquire skills in writing research proposals and articles that follow the design research paradigm. They will learn how to publish such research.

According to [van Aken, 2004], *"Design science research has the following characteristics: (a) research questions are driven by field problems, (b) there is an emphasis on solution-oriented knowledge, linking interventions or systems to outcomes, as the key to solve field problems, (c) the justification of research products is largely based on pragmatic validity"*.

## 2 Course Objectives

[Hevner and Chatterjee, 2010] and [Kuechler and Vaishnavi, 2008] detail the emergence of IS design research (ISDR) and how it became a distinct line of research within the IS field. [Iivari, 2007] defines IS as an *"applied science of meta-artefacts"*. An artefact is broadly defined as *"those bundles of cultural properties packaged in some socially recognisable form such as hardware and software"* [Orlikowski and Iacono, 2001].

Design science in information systems research has been well defined in [March and Smith, 1995]. Recently, several papers promoting design science in IS have been published. Among them, a largely diffused paper [Hevner et al., 2004] consolidated artefact-based research and design research in IS, and established IS design research as a legitimate alternate way of doing research to the more established empirical IS research. Different aspects of design science in IS research have been considered in the literature: framework and guidelines [Hevner et al., 2004], paradigms and theses [Iivari, 2007], taxonomy and theory [Gregor and Jones, 2007], method and process [Peffers et al., 2008], and patterns [Vaishnavi and Kuechler, 2008].

Upon completion of this course, the participants will have a general understanding of the current state and trends in design research in information systems, and be aware of design paradigms, frameworks, theories, methods, patterns, evaluation approaches, and rationales.

Furthermore, the participants will be able to use these design techniques for reviewing papers, sketching research proposals, and writing articles and theses.

### 3 Course Materials

Weekly reading materials will acquaint the participants with the topic to be covered in the upcoming class. Students are required to read all of them for the course. The assigned reading list is provided in the "Course Schedule" section of this syllabus.

The following text books give a comprehensive view on design research in IS:

Hevner, A. and Chatterjee, S. (2010). *Design Research in Information Systems: Theory and Practice*. Integrated Series in Information Systems. Springer.

Vaishnavi, V. and Kuechler, W. (2008). *Design Science Research Methods and Patterns: Innovating Information and Communication Technology*. Auerbach Publications.

### 4 Course Requirements

Class preparation, attendance and participation are vital to a productive and stimulating learning environment. Allow ample time to read and reflect on the assigned readings prior the class period. Further details on the objectives, contents, and the report structure will be presented during the course.

Student will conduct a mini-project for writing a research proposal or an article that could be submitted to a conference or a scholarly journal, in a topic area that you could choose in your research area (or may be chosen from a set of areas suggested by the instructor).

### Grading Criteria

For grading purpose, activities will be issued based on the following scheme:

Participation	50%
Research proposal or article	50%

### 5 Course Schedule

#### Design Science Paradigm

[Hevner et al., 2004] derive seven guidelines from fundamental principle of design-science research in order to conduct a good design research. The design-science research produces artefacts (Guideline 1), which must be relevant to a given environment (Guideline 2). The artefact must yield utility and then must be evaluated (Guideline 3). Novelty is similarly crucial and design research must provide a novel contribution (Guideline 4). In this way, design research is apart from the practice of design. Design research must balance rigor and relevance (Guideline 5). Design science is inherently iterative and enables a search process whereby a problem space is constructed and a mechanism enacted to find an effective solution (Guideline 6). Finally, design research results must be communicated to both technical and management audiences (Guideline 7).

In the same vein, [Iivari, 2007] defines the key properties of four design science research paradigms: ontology, epistemology, methods, and ethics. Moreover, he proposed twelve theses that summarizes the analysis of IS as a design science.

DATE	TOPIC	READING
March 6	Design paradigm and framework	[Hevner et al., 2004] [Iivari, 2007]

## IS Design Theory

Inspired by [Walls et al., 1992], [Gregor and Jones, 2007] developed a so-called Information Systems Design Theory (ISDT). They proposed a taxonomy with eight components of design theories: (1) purpose and scope, (2) constructs, (3) principles of form and function, (4) artifact mutability, (5) testable propositions, (6) justificatory knowledge (kernel theories), (7) principles of implementation, and (8) an expository instantiation. This paper mainly focused on the structural components of a design theory, but the authors claimed that *"listed theory components give some guidelines to what might be included in an article or thesis that reports constructive research"*.

DATE	TOPIC	READING
March 13	Design theory and ontology	[Gregor and Jones, 2007] [Walls et al., 1992]

## Design Research Method

On their side, [Peppers et al., 2008] focused on design research methodology, which present, demonstrate, and evaluate a research process or, what they call, a Design Science Research Method (DSRM). The process includes six steps or stages: (1) problem identification and motivation, (2) definition of the objectives for a solution, (3) design and development, (4) demonstration, (5) evaluation, and (6) communication. The authors stated in their paper that their research *"represents a unique effort to formally define a research methodology for use in IS"*.

More recently, [Sein et al., 2011] propose action design research (ADR), which *conceptualizes the research process as containing the inseparable and inherently interwoven activities of building the IT artifact, intervening in the organization, and evaluating it concurrently*.

DATE	TOPIC	READING
March 20	Design process and method	[Peppers et al., 2008] [Sein et al., 2011]

## Design Science Research Patterns

[Vaishnavi and Kuechler, 2008] adopted an original attitude and suggested patterns to represent how design science research could be conducted. The authors claimed that *"patterns are excellent mechanism [...] that can both communicate goals and philosophy of design science research as well as provide firm direction to a researcher new to the discipline"*.

Several of these patterns propose a broad range of evaluation strategies, also analyzed by [Pries-Heje et al., 2008] who develop an evaluation framework using well-known quality criteria an important asset. The framework encompasses both ex ante and ex post orientations as well as naturalistic settings (e.g., case studies) and artificial settings (e.g., lab experiments) for DSR evaluation".

DATE	TOPIC	READING
March 27	Design patterns and evaluation	[Vaishnavi and Kuechler, 2008] [Pries-Heje et al., 2008]

## C-K Theory for Reasoning in Design

Researchers in the IS field have tried to study different aspects of design science. So far, it seems that the design activity, or "design reasoning" has not received much attention from the IS community. We propose to use a theory developed in engineering fields in order to solve this issue. The *C-K theory* [Hatchuel and Weil, 2009] is considered to be a good candidate to deal with the design reasoning. In order to illustrate its use in IS, we instantiate the *C-K theory* on one of our recent research .

DATE	TOPIC	READING
April 3	Design rationale and C-K theory <i>Deliverable - Article</i>	[Hatchuel and Weil, 2009] [Ondrus and Pigneur, 2010]

## 6 Class patterns

1. (*Language*)  
The course is given in both English and French; the course material is in English.
2. (*Classroom attendance and contribution*)  
Students are expected to attend all classes and group meetings; class participation grades will be significantly reduced for absences. Individual contributions to class sessions are very important and will be evaluated for the course grade.
3. (*Plagiarism*)  
Copying work from the Internet or other sources without reference or acknowledgement is considered plagiarism, and subject to disciplinary action, as enforced by the University of Lausanne.

## References

- [Gregor and Jones, 2007] Gregor, S. and Jones, D. (2007). The anatomy of a design theory. *Journal of the Association for Information Systems*, 8(5):312–335.
- [Hatchuel and Weil, 2009] Hatchuel, A. and Weil, B. (2009). C-K design theory: an advanced formulation. *Research in Engineering Design*, 19(4):181–192.
- [Hevner and Chatterjee, 2010] Hevner, A. and Chatterjee, S. (2010). *Design Research in Information Systems: Theory and Practice*. Integrated Series in Information Systems. Springer.
- [Hevner et al., 2004] Hevner, A., March, S., Park, J., and Ram, S. (2004). Design science in information system. *MIS Quarterly*, 28(1):75–105.
- [Iivari, 2007] Iivari, J. (2007). A paradigmatic analysis of information systems as a design science. *Scandinavian Journal of Information Systems*, 19(2):39–64.
- [Kuechler and Vaishnavi, 2008] Kuechler, W. and Vaishnavi, V. (2008). The emergence of design research in information systems in north america. *Journal of Design Research*, 7(1):1–16.
- [March and Smith, 1995] March, S. and Smith, G. (1995). Design and natural science research on information technology. *Decision Support Systems*, 15(4):251–266.
- [Ondrus and Pigneur, 2010] Ondrus, J. and Pigneur, Y. (2010). C-k design theory for information systems research. In *Proc. 4th International Conference on Design Science Research in Information Systems and Technology (DESRIST'09)*, Poster. ACM.
- [Orlikowski and Iacono, 2001] Orlikowski, W. and Iacono, S. (2001). Research commentary: Desperately seeking the "IT" in IT research—a call to theorizing the it artifact. *Information Systems Research*, 12(2):121–134.
- [Peppers et al., 2008] Peppers, K., Tuunanen, T., Rothenberger, M., and Chatterjee, S. (2008). A design science research methodology for information systems research. *Journal of Management Information Systems*, 24(3):45–77.

- [Pries-Heje et al., 2008] Pries-Heje, J., Baskerville, R., and Venable, J. (2008). Strategies for design science research evaluation. In *Proceedings, 16th European Conference on Information Systems*, Galway: National University of Ireland.
- [Sein et al., 2011] Sein, M., Henfridsson, O., Purao, S., Rossi, M., and Lindgren, R. (2011). Action design research. *MIS Quarterly*, 35(1):37–56.
- [Vaishnavi and Kuechler, 2008] Vaishnavi, V. and Kuechler, W. (2008). *Design Science Research Methods and Patterns: Innovating Information and Communication Technology*. Auerbach Publications.
- [van Aken, 2004] van Aken, J. (2004). Management research based on the paradigm of the design science: The quest for field-tested and grounded technological rules. *Journal of Management Studies*, 41(2):219–246.
- [Walls et al., 1992] Walls, J., Widmeyer, G., and Sawy, O. E. (1992). Building an information system design theory for vigilant EIS. *Information Systems Research*, 3(1):36–59.

The students can access the *BCU* digital library (<http://www.unil.ch/codul/page26769.html>), for consulting many useful databases (*ABI/Inform*, *Business Source Premier*, *ScienceDirect*, *Blackwell*, *Ingenta*, *Kluwer*, *JSTOR*, ...).