Design Science Research for Information Systems

Seminar Human Smart Cities
24.09.2021

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HUMAN-IST
HUMAN CENTERED INTERACTION SCIENCE & TECHNOLOGY

Basics + Background

Types of Research

Descriptive vs Analytical

Applied vs Fundamental

Quantitative vs Qualitative

Conceptual vs Empirical

Others...

Information Systems Research

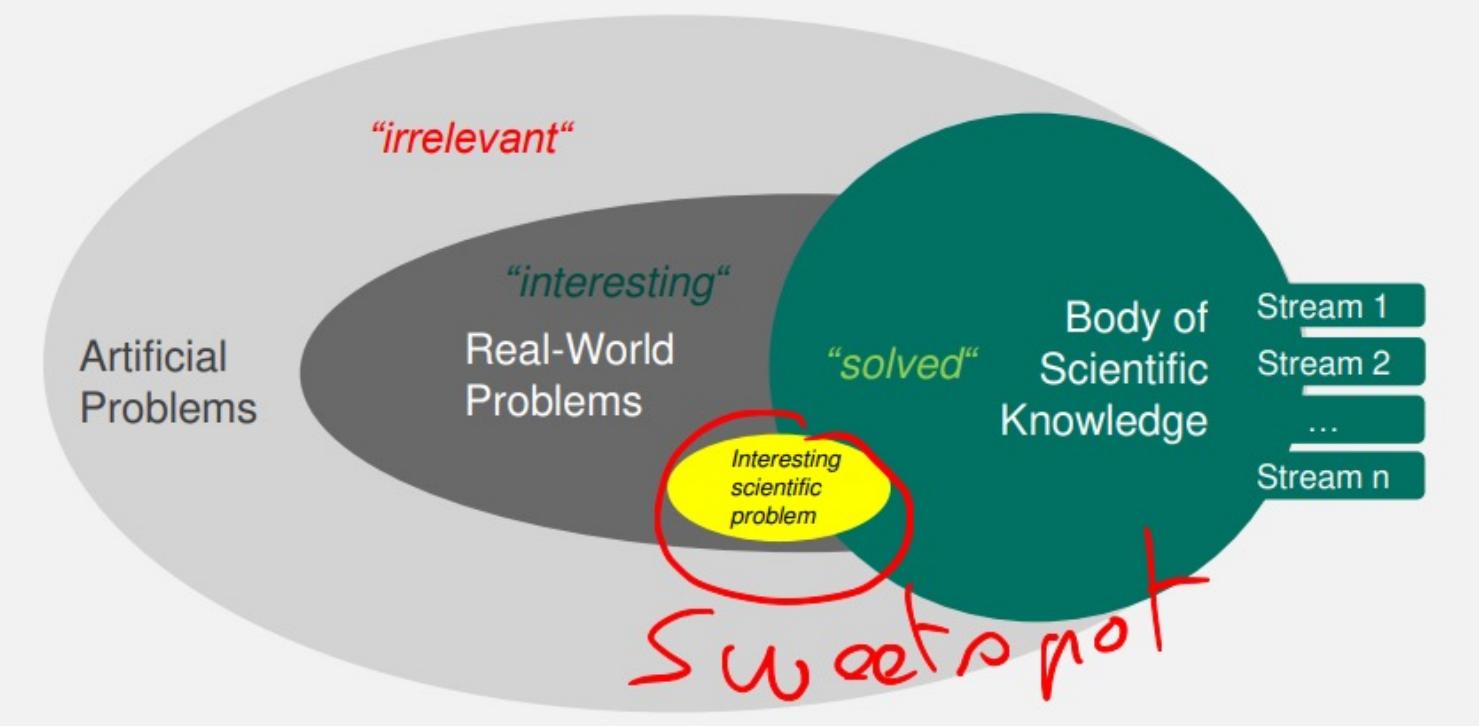
Must respond to a dual mission:

1. Make a theoretical contribution
2. Assist in solving current and anticipated problems of practitioners

Design Science Research

- Design science research is a research paradigm in which a designer answers questions relevant for human problems via the creation of innovative **artifacts**, thereby contributing new knowledge to the body of scientific evidence.

Hevner & Chatterjee (2010)


"irrelevant"
"interesting"
Artificial Problems
Real-World Problems
"solved"
Body of Scientific Knowledge
Stream 1
Stream 2
…
Stream n
Interesting scientific problem
Sweet spot

Design Science Approach

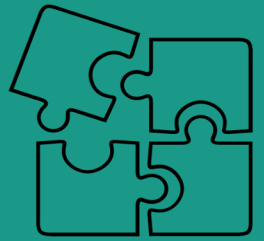
- Construction-oriented view of IS research.
- Centered around designing and building innovative *IT artifacts*.
- Provides a schema to do research, while providing knowledge relevant for practitioners.

Artifact?

Material and organizational features
that are socially recognized as bundles of hardware
and/or
software.

e.g. Algorithms, human-computer interfaces,
methodologies, design principles ...

Guidelines



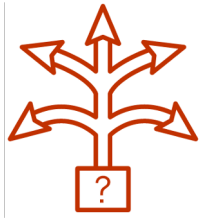
1 Design as an Artifact

2 Problem Relevance

3 Design Evaluation

4 Research Contributions

5 Communication of Research



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.

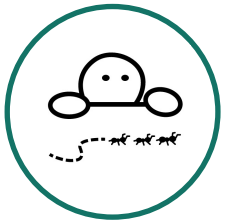
2 Problem Relevance

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.

Evaluation Methods I

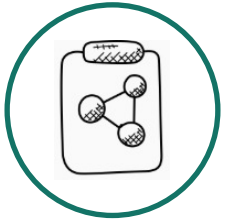


Observational

Case Study
Field Study

Analytical

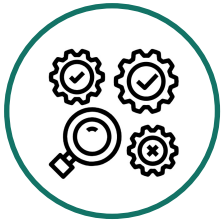
Statistical
Architectural
Optimization
Dynamic



Experimental

Controlled Experiment
Simulation

Evaluation Methods II



Testing

Functional (Black Box)
Structural (White Box)

Descriptive

Informed Argument
Scenarios

Evaluation Methods:

Table 2. Design Evaluation Methods	
1. Observational	Case Study: Study artifact in depth in business environment
	Field Study: Monitor use of artifact in multiple projects
2. Analytical	Static Analysis: Examine structure of artifact for static qualities (e.g., complexity)
	Architecture Analysis: Study fit of artifact into technical IS architecture
	Optimization: Demonstrate inherent optimal properties of artifact or provide optimality bounds on artifact behavior
	Dynamic Analysis: Study artifact in use for dynamic qualities (e.g., performance)
3. Experimental	Controlled Experiment: Study artifact in controlled environment for qualities (e.g., usability)
	Simulation – Execute artifact with artificial data
4. Testing	Functional (Black Box) Testing: Execute artifact interfaces to discover failures and identify defects
	Structural (White Box) Testing: Perform coverage testing of some metric (e.g., execution paths) in the artifact implementation
5. Descriptive	Informed Argument: Use information from the knowledge base (e.g., relevant research) to build a convincing argument for the artifact's utility
	Scenarios: Construct detailed scenarios around the artifact to demonstrate its utility

Discount Usability

- Defined by Nielsen Norman Group
- Simple user testing with **5 participants**, paper prototyping, and heuristic evaluation offer a cheap, fast, and early focus on usability, as well as many rounds of iterative design.

5 participants but the right ones!

https://www.nngroup.com/articles/discount-usability-20-years/
https://www.nngroup.com/articles/why-you-only-need-to-test-with-5-users/

4 Research Contributions

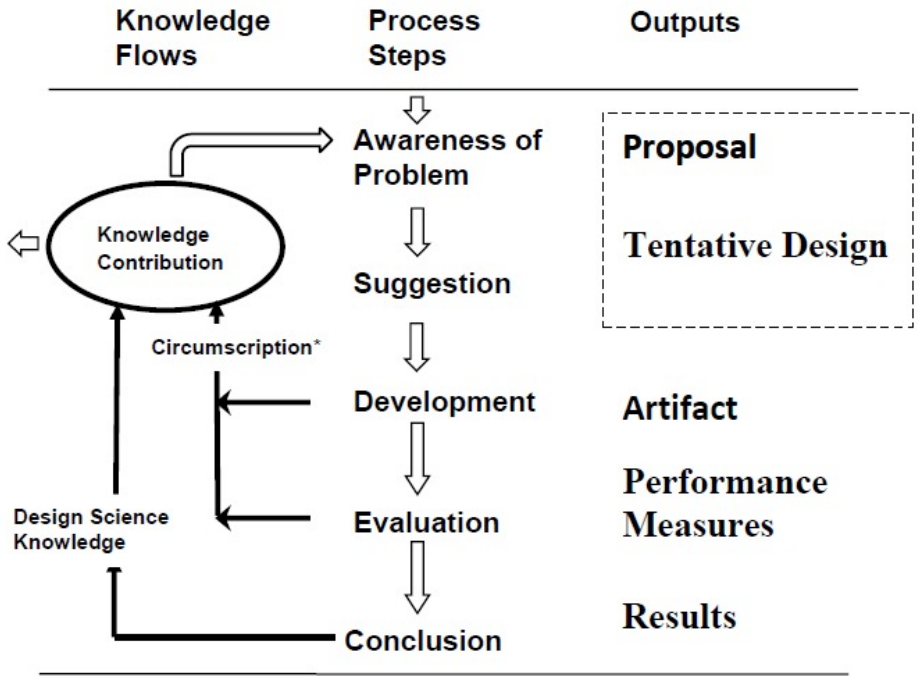
Effective design-science research must provide clear and verifiable contributions in the areas of the design artifact, design foundations, and/or design methodologies.

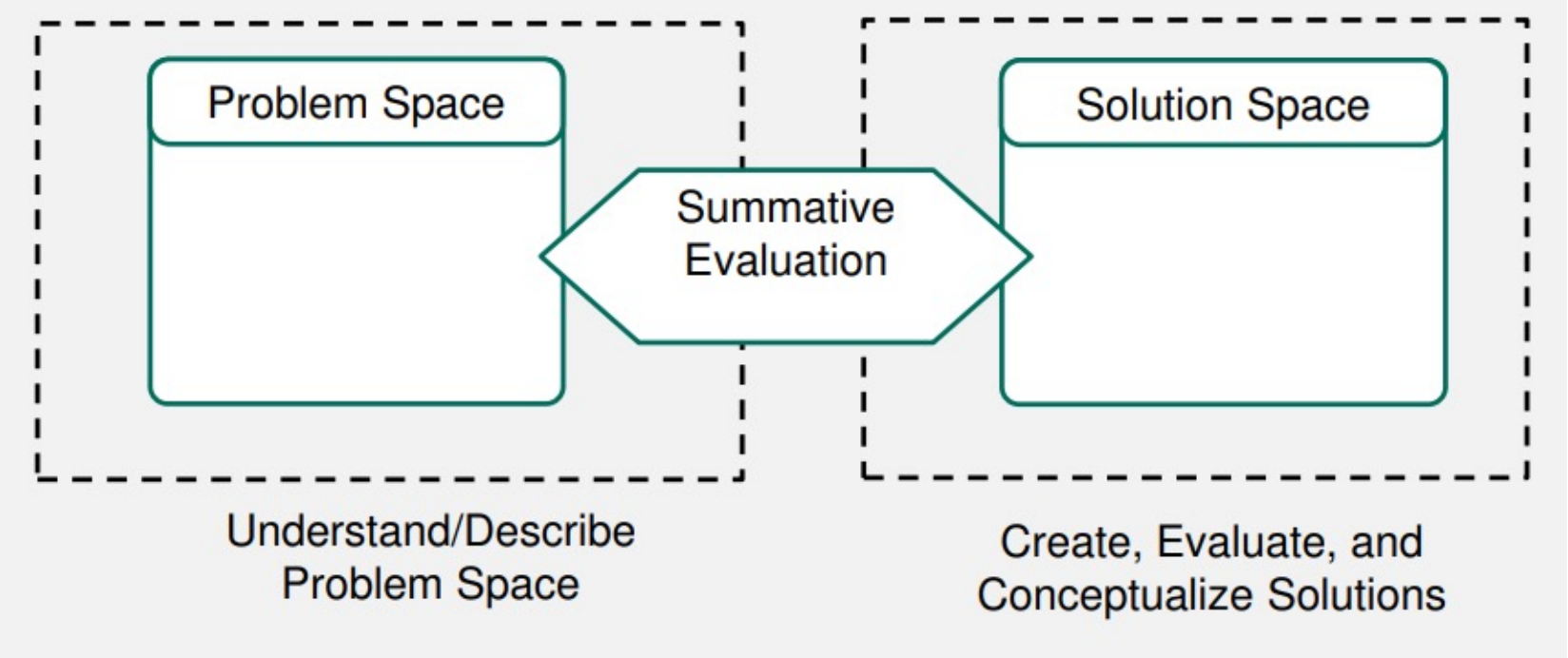
1. Artifact Itself
2. Development of the Artifact
3. Evaluation

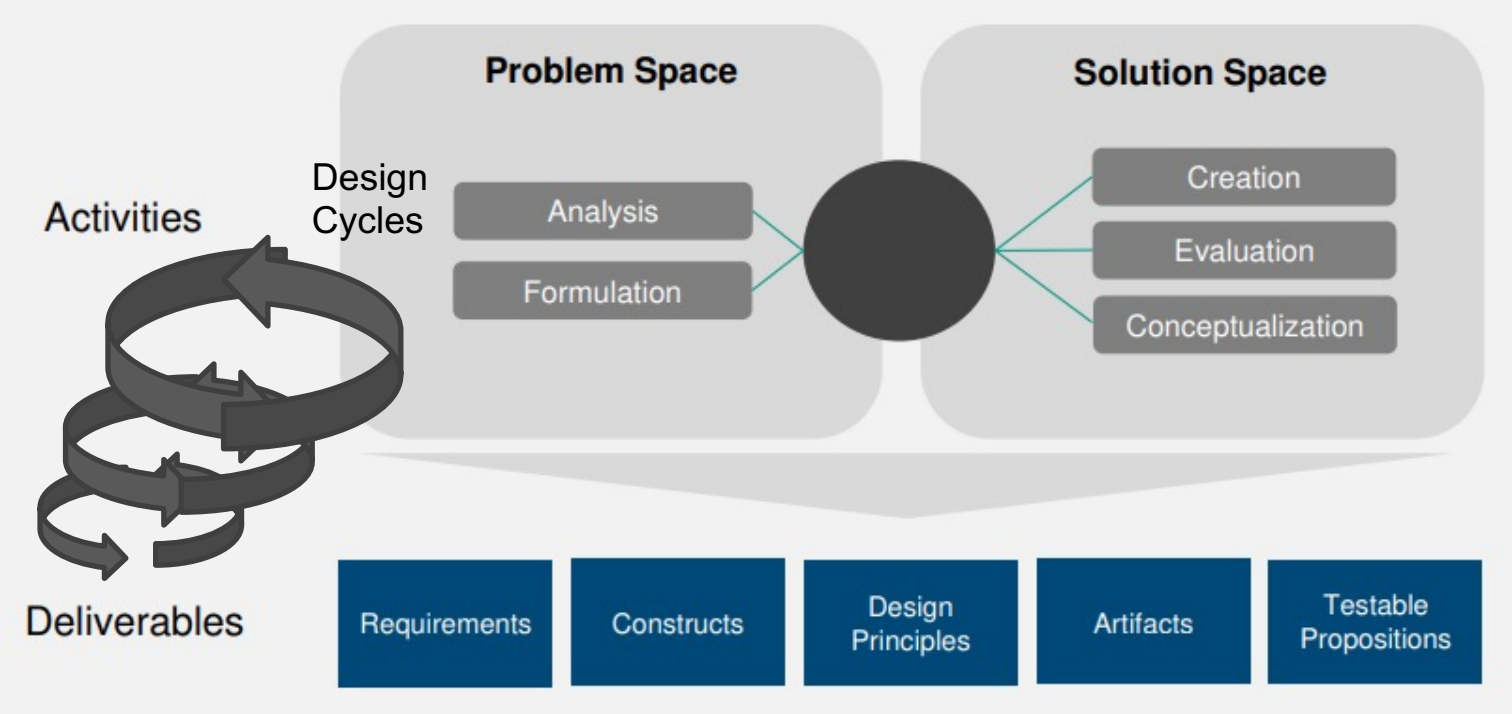
5 Communication of Research

Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

DS Research Process Model (Cycle)




Problem Space
Solution Space
Summative Evaluation
Understand/Describe Problem Space
Create, Evaluate, and Conceptualize Solutions


Problem Space
Solution Space
Activities
Design Cycles
Analysis
Formulation
Creation
Evaluation
Conceptualization
Deliverables
Requirements
Constructs
Design Principles
Artifacts
Testable Propositions

Instantiation of the Artifact

- Sketches & Wireframes
- Prototype
  - From scratch
  - No/Low-Code Development

carbonmade Stacker
AppDrag Carrd
Adalo Airtable
Landen AppGyver
webflow BUILDER.IO
bubble tabbli
sheet2site

Example

- https://chats.landbot.io/v3/H-956941-PNSF83UGYDZ780WJ/index.html
- https://airtable.com/shrfaWPCsF39lXWyr
- https://app.landbot.io/gui/bot/1029469/builder
- https://app.landbot.io/gui/bot/1029469/metrics/overview/bot/1029469/analytics

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Hevner, A., & Chatterjee, S. (2010). Design research in information systems: theory and practice (Vol. 22). Springer. DOI, 10, 978-1.