

Design and Creation

SWAL

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Design and Creation - Motivation

*„The ultimate goal of computer science and programming:
The art of designing artifacts to solve intricate problems.
Some call it the art of constructive thinking.“*



"Star Tour Preview R2-D2 and C3PO" by gordontarpley
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Defining Design and Creation

Design Science and Design Science Research

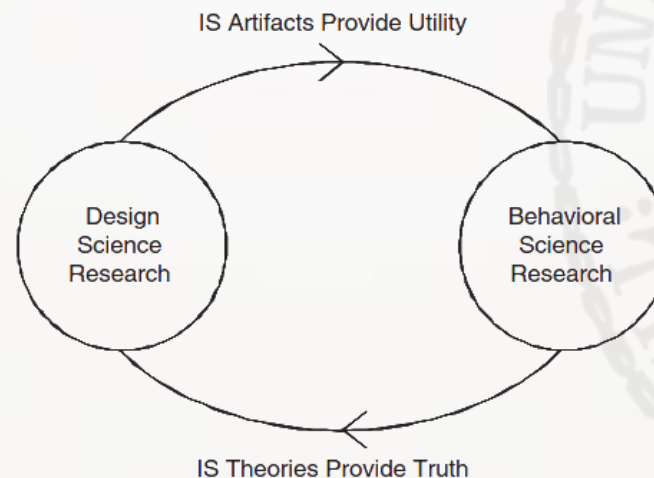
- Design Science
 - Know-how for creating artifacts
 - Design is both a process and a product
- Design Science Research
 - Creation of missing knowledge
 - Design of novel or innovative artifacts
 - Analysis of the use and performance of artifacts
 - Problem solving paradigm



Defining Design and Creation

Design Science vs. Natural Science

- Design Science
 - Solve problems
 - Produce and apply knowledge to create effective artifacts
 - Derives from engineering
 - Build and Evaluate
- Natural Science
 - Understand reality
 - Produce general theoretical knowledge
 - Derives from nature
 - Theorize and Justify



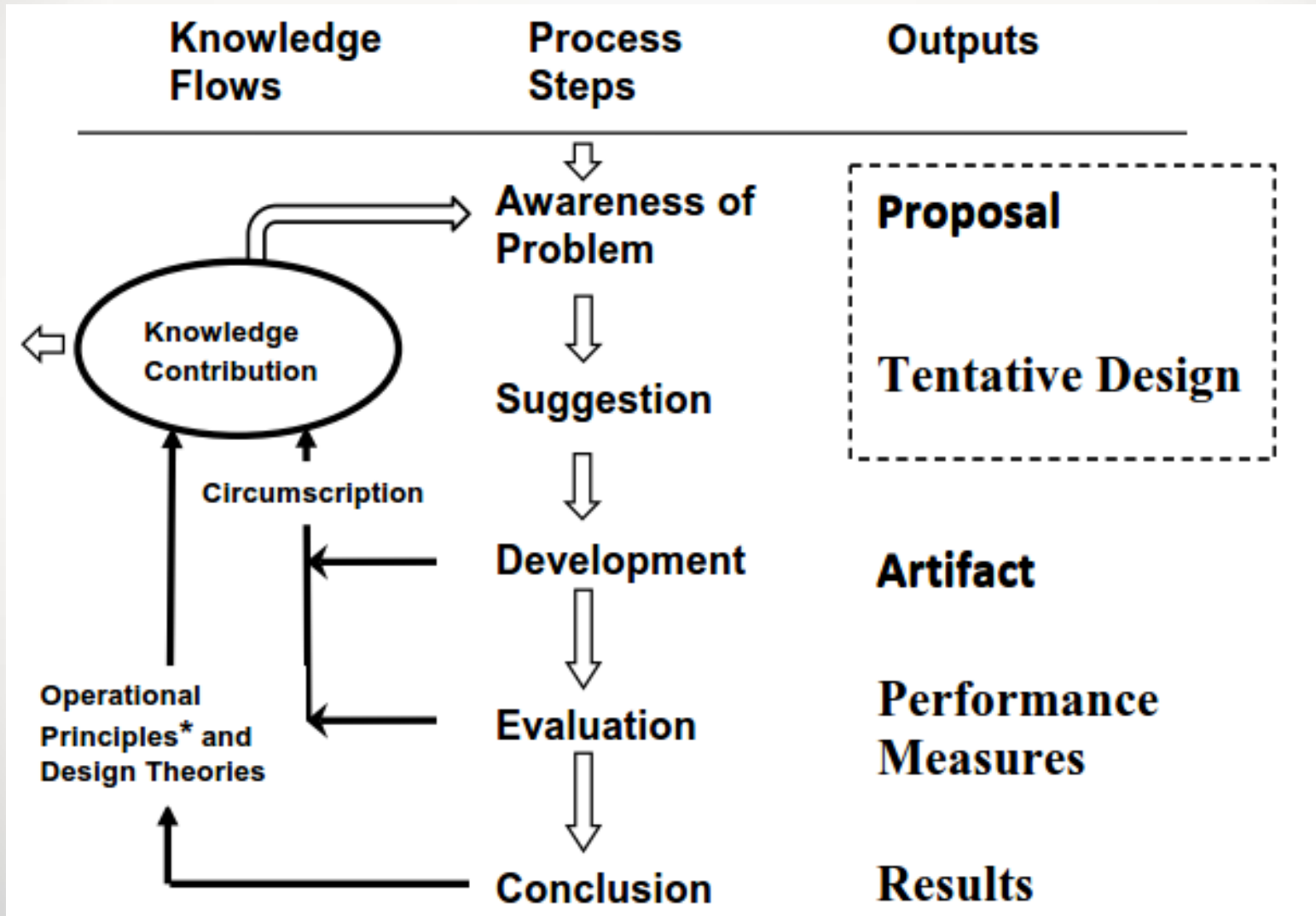
Defining Design and Creation

Normal Design vs. Design Science Research

- Normal Design
 - Is routine
 - Desires a smooth process without any risks
- Design Science Research
 - Creates new interesting knowledge
 - Demonstration of academic qualities
 - Profits from unpredictable situations
 - „We don't know how to do this yet“
 - Focuses on risky and uncertain areas
 - Improvement, Invention, Exaptation

Design and Creation Process

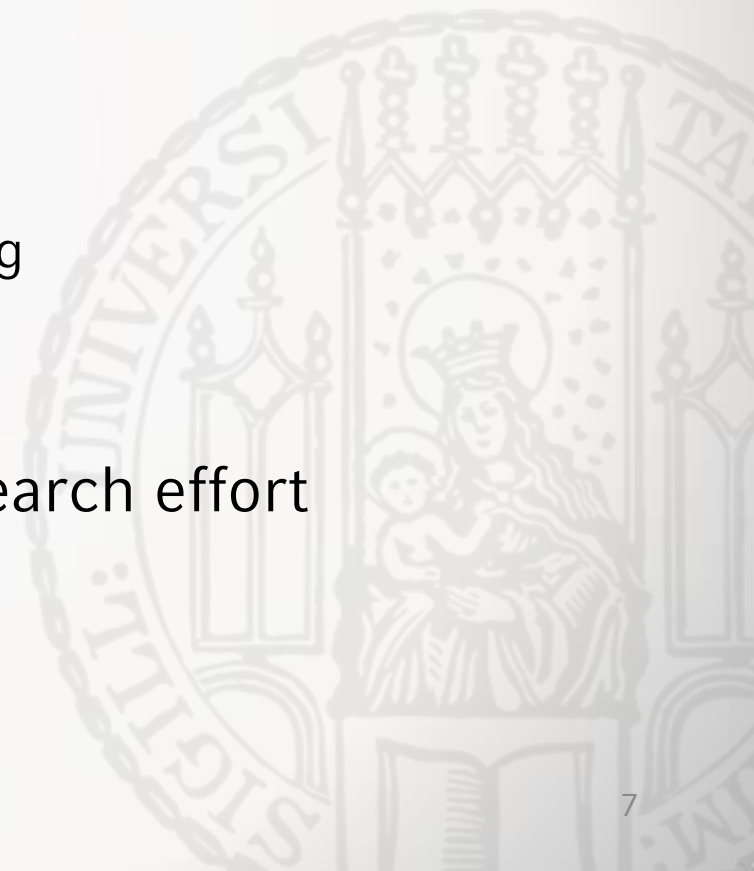
Design Science Research Process Model



Design and Creation Process

Design Science Research Process Model - Awareness

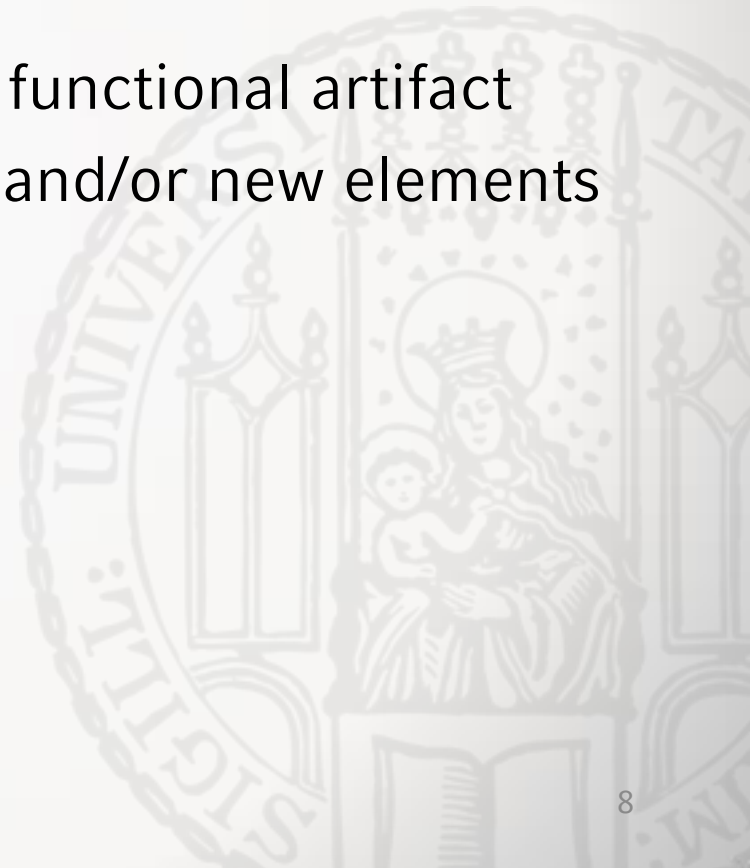
- Awareness
 - Recognition and articulation problems
 - Can come from:
 - Studying literature
 - Findings in another discipline
 - Expressing the need for something
 - Field research
 - New developments in technology
 - Output: Proposal for a new research effort



Design and Creation Process

Design Science Research Process Model - Suggestion

- Suggestion
 - Tentative idea of how the problem might be addressed
 - Creative step to envision a new functional artifact
 - Novel configuration of existing and/or new elements
 - Output: Tentative Design



Design and Creation Process

Design Science Research Process Model - Development

- Development
 - Implementation of the tentative design
 - Depends on the kind of the artifact
 - Output: Artifacts
- Artifacts
 - Constructs
 - Models
 - Methods
 - Instantiations



Design and Creation Process

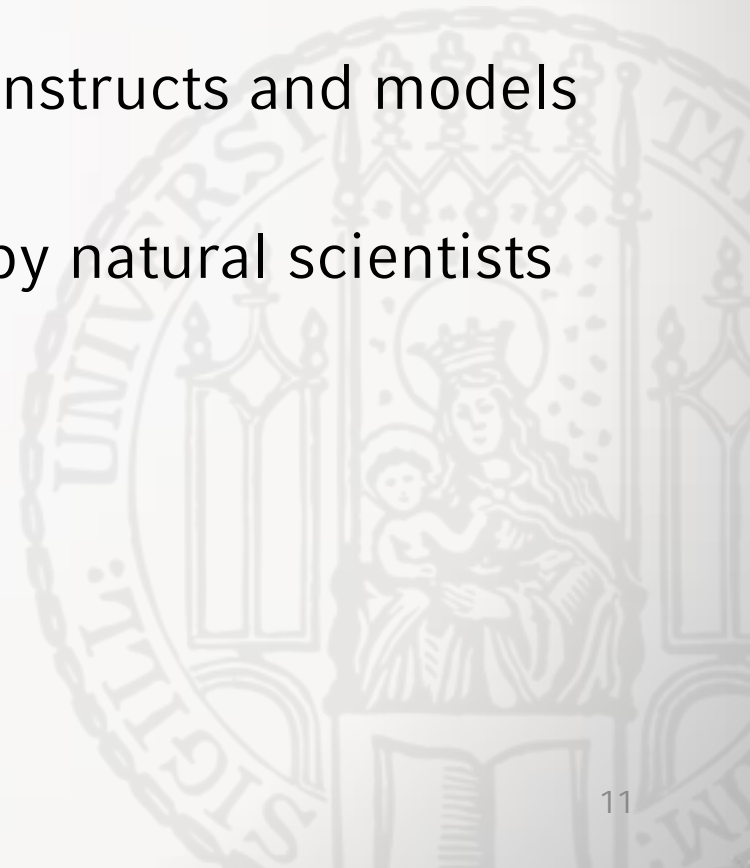
Design Science Research Process Model - Artifacts

- Constructs
 - Form the vocabulary of a domain
 - Describe problems within the domain and specify their solutions
 - e.g. notion of entities, objects, data types
- Models
 - Combination of constructs
 - Represent situations as problem and solution statements
 - Concern of models is utility
 - e.g. UML, use case scenario, storyboards

Design and Creation Process

Design Science Research Process Model - Artifacts

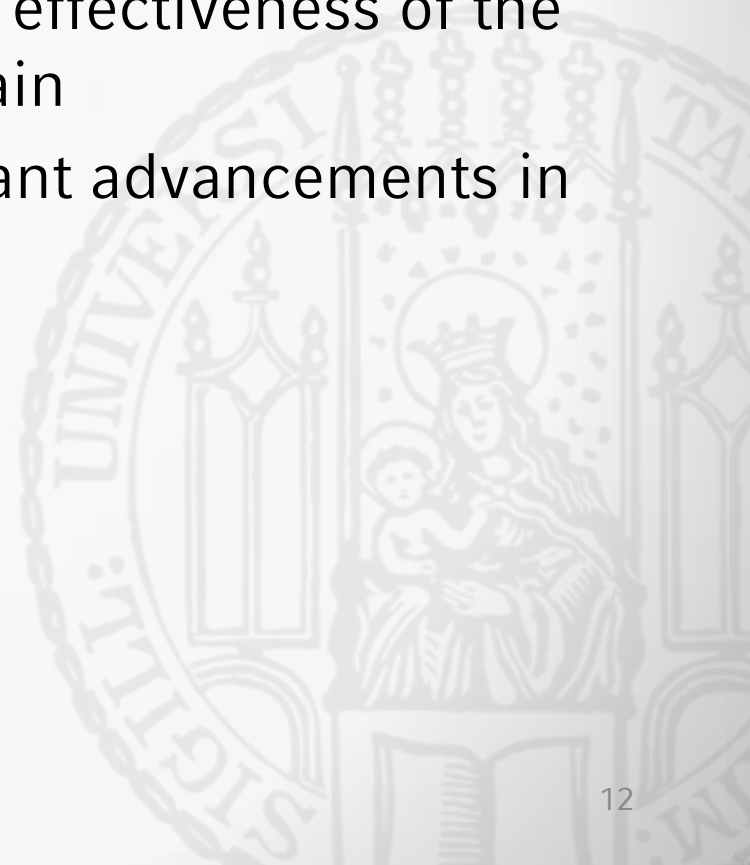
- Methods
 - Set of steps used to perform a task and/or solve a problem
 - Based on a set of underlying constructs and models of the solution space
 - Methodological tools are used by natural scientists
 - e.g. an algorithm or manual



Design and Creation Process

Design Science Research Process Model - Artifacts

- Instantiations
 - Realization of artifacts in its environment
 - Demonstrate the feasibility and effectiveness of the models and methods they contain
 - Their study can lead to significant advancements in design and natural science
 - e.g. software, hardware



Design and Creation Process

Design Science Research Process Model - Evaluation

- Evaluation
 - „How well does it work“
 - Metrics and measurements are required
 - e.g. functionality, completeness, performance, usability, aesthetics, reliability, ...
 - Hypothesis about the behavior of the artifacts
 - Analysis either confirms or contradicts a hypothesis
 - Leads to new awareness (iterative) or to conclusion
 - Output: Performance measures

Design and Creation Process

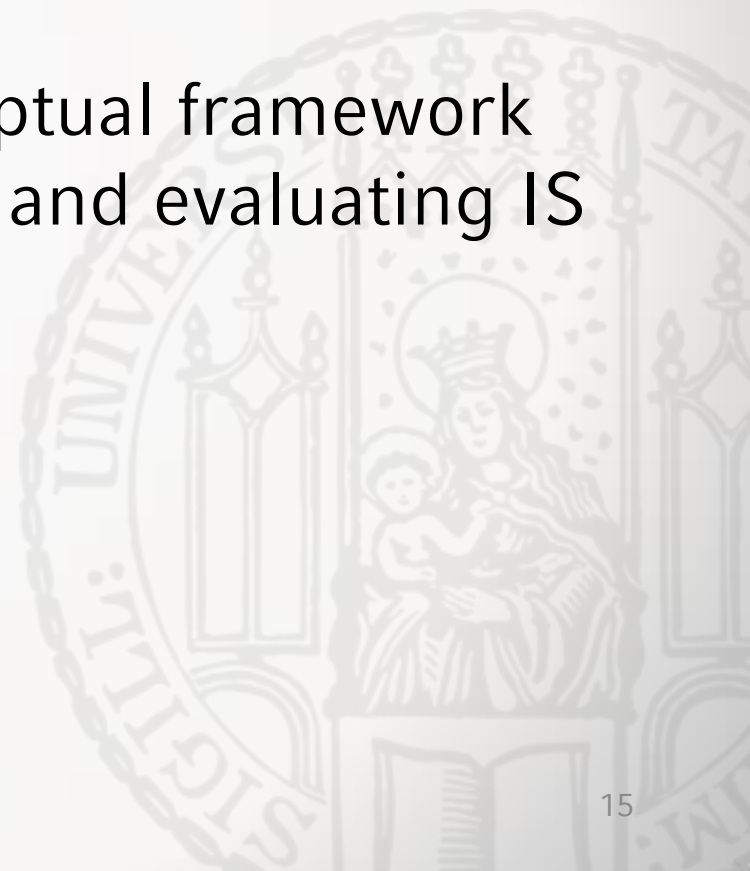
Design Science Research Process Model - Conclusion

- Conclusion
 - Determine why and how the artifact worked or did not work within its environment
 - Results of the research effort consolidated and written up
 - Knowledge categorized either as firm or as loose ends
 - Theorize and justify principles from natural science can be applied
 - Output: Results (Publications)

Design and Creation Research in IS & Computing

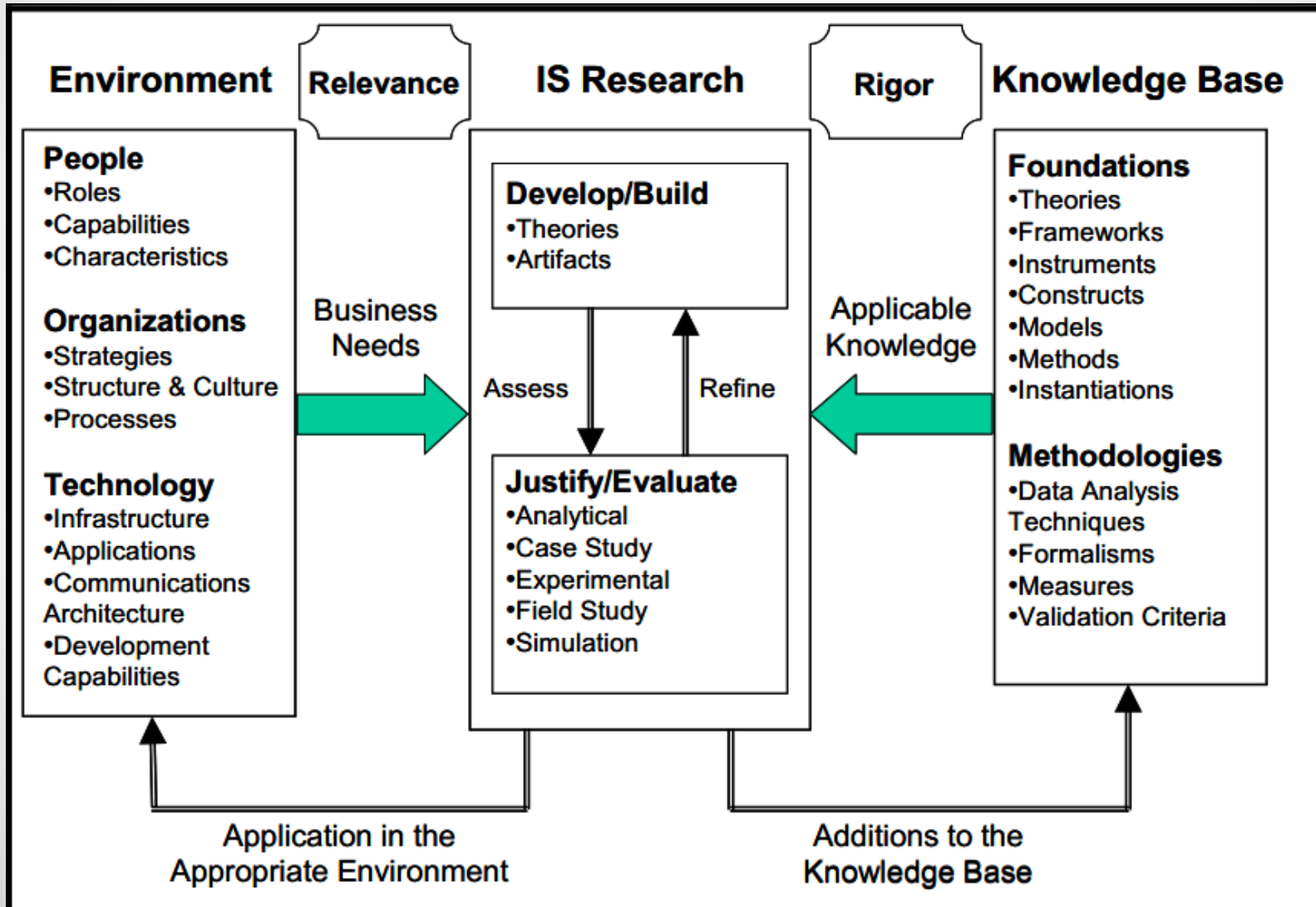
IS Research Framework

- Information Systems are implemented within an organization for the purpose of improving effectiveness and efficiency
- Hevner et al. created a conceptual framework for understanding, executing and evaluating IS research



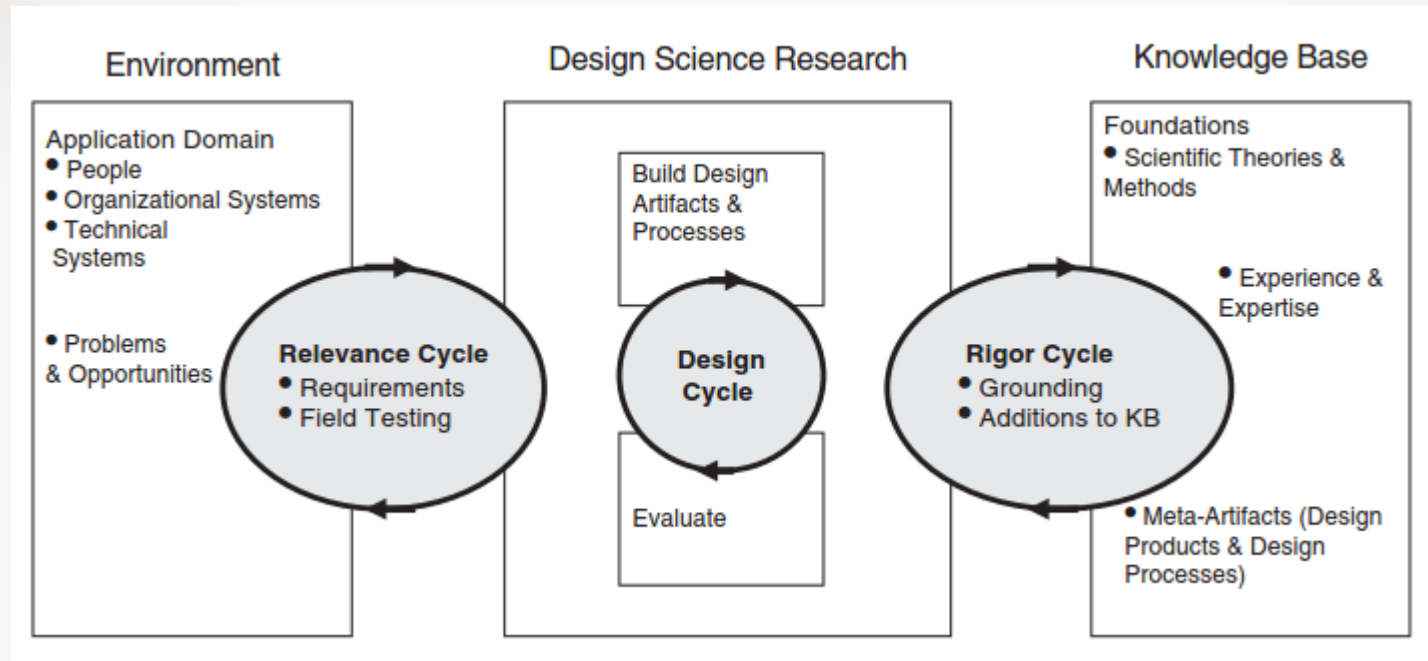
Design and Creation Research in IS & Computing

IS Research Framework



Design and Creation Research in IS & Computing

Design Science Research Cycle



- Relevance Cycle: Provides the requirements
- Rigor Cycle: Provides past knowledge
- Design Cycle: Design alternatives until a satisfactory design is reached

Design and Creation Research in IS & Computing

Effective Design Science Research Guidelines

- To conduct and evaluate good design science research in IS
- Assists researchers, reviewers, editors, and readers to understand the requirements for effective design science research



Design and Creation Research in IS & Computing

Effective Design Science Research Guidelines

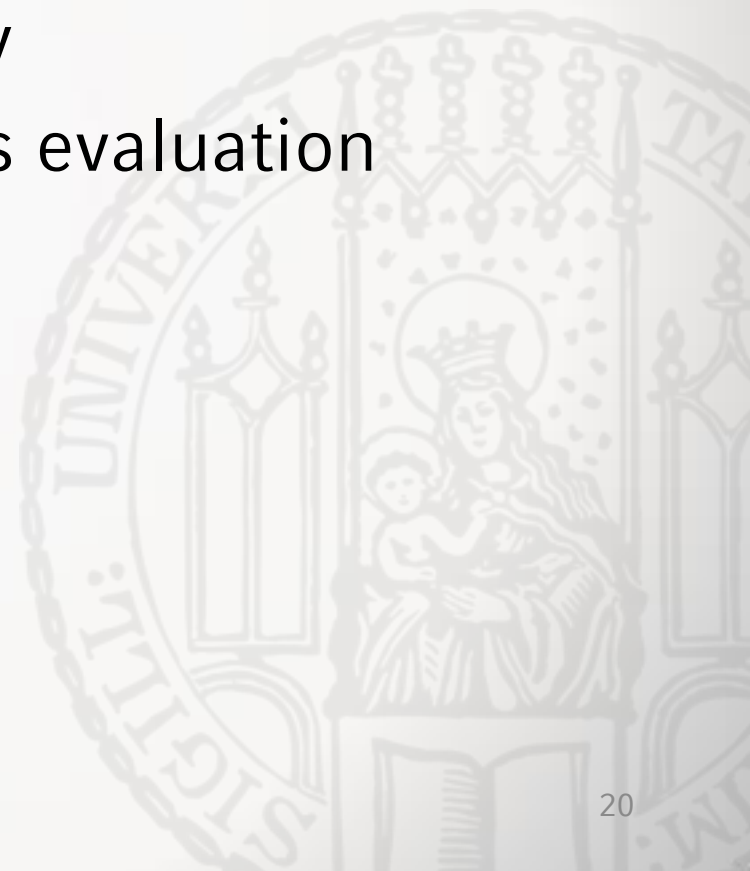
- 7 Guidelines
 - Design as an Artifact
 - Problem Relevance
 - Design Evaluation
 - Research Contributions
 - Research Rigor
 - Design as a Search Process
 - Communication of Research



Design and Creation Research in IS & Computing

Challenges in Design Science Research

- Inadequate knowledge base
- „No relationship to real world environment“
- Rapid advances in technology
- Difficulty in applying rigorous evaluation methods



Advantages and Disadvantages of Design and Creation Research

- Advantages
 - Something tangible to show
 - Appeals to people who enjoy technical and creative development work
 - Expected mode of research in some computing areas
 - Plenty of scope for proposing and developing new IT artifacts, therefore making a contribution to knowledge
- Disadvantages
 - Justification of research may be required
 - Risky if you do not have the technical or artistic skills
 - Difficult to generalize
 - Success may depend on the researchers being present
 - May produce perishable research

Take-Away Message

- Important part of technological development
- Inseparable from natural science
- Creation of new knowledge is sought
- To solve problems through designing innovative artifacts
- Build and Evaluate
- Iterative Process - No „perfect“ product
- Use of frameworks in IS (7 Guidelines) is recommended

Literature

- [1] A. Hevner, S. Chatterjee, Design Research in Information Systems , Integrated Series 9 in Information Systems 22, DOI 10.1007/978-1-4419-5653-8_2, Springer Science+Business Media, LLC 2010
- [2] Vaishnavi, V. & Kuechler, W. (2013). Design research in information systems. Retrieved 28 April 2014 from <http://desrist.org/design-research-in-information-systems/>
- [3] von Alan, R. Hevner, et al. "Design science in information systems research." MIS quarterly 28.1 (2004): 75-105.
- [4] Oates, Briony J. Researching information systems and computing, Chapter 8 – Design and Creation. Sage, 2005.
- [5] March, S. and G. Smith (1995) Design and natural science research on information technology, Decision Support Systems 15, pp. 251–266
- [6] Takeda, H., Veerkamp, P., Tomiyama, T., and Yoshikawam, H. "Modeling Design Processes," in: AI Magazine, 1990, pp. 37

Discussion

- What makes a design good?
- How can you achieve a good design?
- From existing technologies that you have used, which one do you think was the most innovative? Why?
- In which area do you think will be the next big design innovation?
- Have you ever used design and creation strategies in your past projects? Which problems did you have?

Discussion

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Welcome to FreeDOS

CuteMouse v1.9.1 alpha 1 [FreeDOS]
Installed at PS/2 port
C:\>ver

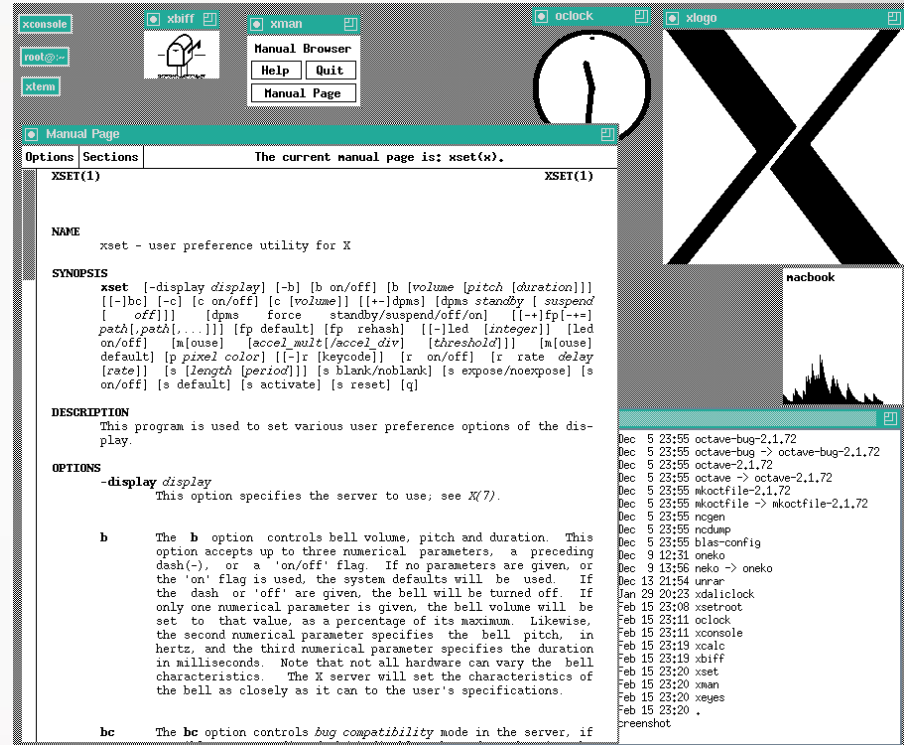
FreeCom version 0.82 pl 3 XMS_Swap [Dec 10 2003 06:49:21]

C:\>dir
Volume in drive C is FREEDOS_C95
Volume Serial Number is 0E4F-19EB
Directory of C:\

FDOS          <DIR>  08-26-04  6:23p
AUTOEXEC.BAT  435    08-26-04  6:24p
BOOTSECT.BIN  512    08-26-04  6:23p
COMMAND.COM   93,963 08-26-04  6:24p
CONFIG.SYS    801    08-26-04  6:24p
FDSOBOOT.BIN  512    08-26-04  6:24p
KERNEL.SYS   45,815 04-17-04  9:19p
              6 file(s)    142,038 bytes
              1 dir(s)  1,064,517,632 bytes free

C:\>_
```

http://upload.wikimedia.org/wikipedia/commons/9/94/FreeDOS_Beta_9_pre_release5_%28command_line_interface%29_on_Bochs_sshot20040912.png



<http://upload.wikimedia.org/wikipedia/commons/d/d4/X-Window-System.png>