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.“
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

**Environment**
- People
  - Roles
  - Capabilities
  - Characteristics
- Organizations
  - Strategies
  - Structure & Culture
  - Processes
- Technology
  - Infrastructure
  - Applications
  - Communications
  - Architecture
  - Development
  - Capabilities

**Relevance**
- Business Needs

**IS Research**
- Develop/Build
  - Theories
  - Artifacts
- Justify/Evaluate
  - Analytical
  - Case Study
  - Experimental
  - Field Study
  - Simulation

**Rigor**
- Assess
- Refine
- Applicable Knowledge

**Knowledge Base**
- Foundations
  - Theories
  - Frameworks
  - Instruments
  - Constructs
  - Models
  - Methods
  - Instantiations
- Methodologies
  - Data Analysis
  - Techniques
  - Formalisms
  - Measures
  - Validation Criteria

Application in the Appropriate Environment

Additions to the Knowledge Base
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
• Inseperable from natural science
• Creation of new knowledge is seeked
• 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


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

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-19E8
Directory of C:\

FDOS        <DIR>   00-26-04  6:23p
AUTOEXEC     BAT     435  00-26-04  6:24p
BOOTSECT     BIN     512  00-26-04  6:23p
COMMAND      COM     93,963  00-26-04  6:24p
CONFIG       SYS     801  00-26-04  6:24p
DOSSBOOT     BIN     512  00-26-04  6:24p
KERNEL       SYS     45,815 04-17-04  9:19p

6 file(s)    142,830 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

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