Design Science in Software Engineering

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Background

Empirical software engineering studies *describe, explore, explain*

But we want to *improve* practice too

We work in a specific context, but often want to claim generalizability

Session Goals

build basic understanding of what design science in SE means

understand how it relates to the concepts of empirical software engineering

work with visual abstracts to assess quality and contribution of design science research

Design Science Research in Information Systems



Categorizing design science by knowledge contribution



Wierenga's view

"Design science is the design and investigation of artifacts in context"

Research problems in design science



Subjects of design science



http://bpm2015.q-e.at/wp-content/uploads/2015/09/Roel-Wieringa.pdf

Validating new technology



http://wwwhome.cs.utwente.nl/~roelw/microtutorialDC.pdf



Design Science Research: Visual Abstracts to Communicate and Promote it

Structured abstracts

A structured abstract is an abstract with distinct, labeled sections (e.g., Introduction, Methods, Results, Discussion) for rapid comprehension.



DEX initiation. Seven patients (32%) had concomitant vasopressor support with four (57%) of these

CONCLUSION: Common adverse effects of DEX were noted in this study. The requirement for vasopressor support during therapy warrants further investigation into the safety of DEX in poisoned patients. Larger, comparative studies need to be performed before the use of DEX can be routinely

PMID: 24792780 [PubMed - indexed for MEDLINE]

recommended in poisoned patients.

patients requiring vasopressor support after DEX initiation.

Graphical abstracts...



https://www.elsevier.com/authors/journal-authors/graphical-abstract

COMPONENTS OF AN EFFECTIVE VISUAL ABSTRACT



Visual Abstracts Increase Article Dissemination: a prospective, case-control crossover study



Ibrahim et al. Ann Surg. April 2017.

ANNALS OF SURGERY

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To achieve an *effect* in a *situation* apply this *intervention*

Approach to understand problem Approach to understand problem	n approach Solution(s) hrow the solution of t
Problem relevance	
Scientific rigor	
Novel contributions	

Margaret-Anne Storey, Emelie Engstrom, Martin Host, Per Runeson, Elizabeth Bjarnason

Using a Visual Abstract as a Lens for Communicating and Promoting Design Science Research in Software Engineering.

In Proc of 11th Int Symposium on Empirical Software Engineering and Measurement (ESEM), Nov 2017.

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To better communicate Design Knowledge to the Software Engineering community we propose to use the SE-DSR visual abstract approach



Problem understanding: Based on our experiences

struggling to

evaluate SE

engineering.

articulate and

research from

It is challenging to communicate software engineering research that solves real world problems to fellow researchers and practitioners.

Problem addressed



Evaluation: Applied the visual abstract approach to sample SE papers as a proof of concept to gain preliminary feedback



Design Science is a paradigm used in other fields to frame research that aims to produce design knowledge, but it is underutilized in software engineering. We propose a visual abstract for communicating Software Engineering Design Science Research (SE-DSR) thereby promoting the use of design science and its terminology in software engineering.



Design approach: Alternative visual abstracts were designed using ideas from other visual and structured abstract designs.



Relevance: Industry is often not aware of academic research that could solve their problems. While, researchers are often not aware of related research. This approach may help improve communication between researchers and practitioners about design knowledge that is more accessible than research papers.



Rigor: Iteratively designed a visual abstract approach for communicating design knowledge from a variety of software engineering papers. The concepts we include in the abstract are derived from the design science literature. The approach needs to be evaluated by practitioners and researchers that make a contribution to design knowledge in SE.

Novelty: We propose guidelines for communicating design knowledge in software engineering through a visual abstract.



To achieve an effect in a situation apply this intervention



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Exercise Assignment

- Identify the **Problem** & the **Solution**
 - Extractable from the paper? Guessable?
- Discuss Problem
 - Problem understanding: what is known about the problem (from this paper, in general), what is the context and the impact of the problem?
 - Problem relevance: extent/frequency of problem, impact, impacts which contexts?
- Discuss Proposed Solution
 - What is the proposed solution, how does it address the problem?
 - How was solution evaluated?
 - Are there alternative solution approaches?
 - What was the design process followed?

- Express a **technological rule**: To achieve an **effect** in a **situation** apply this **intervention**
 - What is the desired effect?
 - What is the intervention/solution?
 - For which situations does the intervention cause the desired effect?
- What additional research / information / support is needed for industry to apply this research? E.g. further evaluation, collaboration with researchers, guidelines, tools etc.

ICSE 2014 (selected) best papers

- Saba Alimadadi, Sheldon Sequeira, Ali Mesbah, Karthik Pattabiraman:
 Understanding JavaScript event-based interactions. ICSE 2014: 367-377
- Paige Rodeghero, Collin McMillan, Paul W. McBurney, Nigel Bosch, Sidney K. D'Mello: Improving automated source code summarization via an eye-tracking study of programmers. ICSE 2014: 390-401
- Yepang Liu, Chang Xu, Shing-Chi Cheung:
 Characterizing and detecting performance bugs for smartphone applications. ICSE 2014: 1013-1024
- Thanassis Avgerinos, Alexandre Rebert, Sang Kil Cha, David Brumley: Enhancing symbolic execution with veritesting. ICSE 2014: 1083-1094

Distribution of papers to participants

VA paper #1	VA paper #2
Review VA #2	Review VA #3
VA paper #4	VA paper #3
Review VA #1	Review VA #4

Discussion

on using Visual Abstracts for Design Science Research

What worked well with applying the design science visual abstract to the assigned paper?

Did the visual abstract help you understand the other paper?

What was difficult to capture or read in the VAs?

Do you have suggestions for improving the VA?

How does it compare to structured abstracts? That is, how is it similar but how does it differ?

Would you use these again or suggest others to use them?