LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

UNIVERSITÄT LEIPZIG

Media Informatics Group • Stefan Seitz

Pattern-based Usability Scenarios

Diploma Thesis
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Introduction

Related Work

Proposed Solution

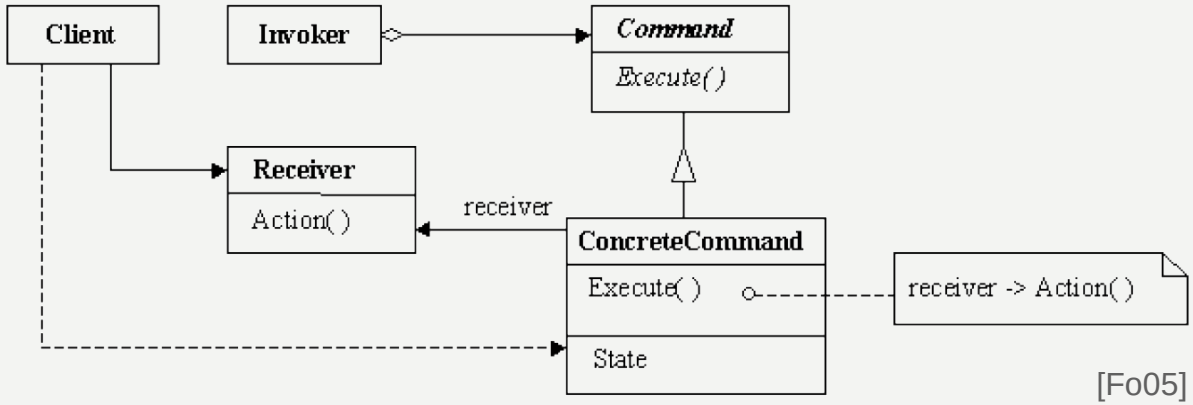
Evaluation

Conclusions

Why to consider usability early in software development?

- Usability requirements with architectural impact
- Example: Undo

Command Pattern



[Fo05]

→ Analysis of software architectures for their support of quality attributes, usability

→ Bettina Biel (Leipzig): SATURN (Software ArchitecTural analysis of Usability Requirements realizatioN)

Usability Requirements Engineering

Developers and external stakeholders (customers, users) are required to contribute requirements and to participate in analysing and specifying them

Common practice:

- (Inappropriate) tools, trainings ↯
  (usability principles, heuristics, guidelines, patterns)
- Excluding stakeholders ↯
  (physical absence / lack of technical language)

Preferable alternatives:

- Speaking the users' language (interactions)
- Integrating technical knowledge in a tool

→ Suggestions:

Scenarios for requirements documentation

- interactions (users' perspective)
- used in requirements engineering, (architecture) analyses

Pre-defined "generic" usability scenarios

- describe general interactions that can be found in software
- contain usability and software engineering knowledge
- basis/template for creating application-specific scenarios
- scenario catalogue as a source of ideas, a checklist
- extendable, expandable (more scenarios, additional information)
- stationary and mobile use being considered

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Folmer (EU-funded STATUS project)

"Architecture-sensitive" usability patterns, "usability properties"

SALUTA (Scenario based Architecture Level UsabiliTy Analysis)

- "Usage profiles", evaluation of support via quality model
- No tools for requirements elicitation

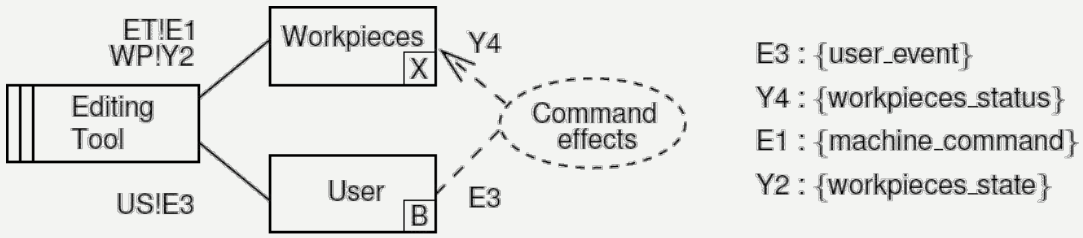
Kazman (Carnegie Mellon University, CMU)

ATAM (Architecture Trade-off Analysis Method)

- Experts derive scenarios from quality model
- Scenario brainstorming in stakeholder session based on goals and scenarios defined by experts

Wentzlaff (University of Duisburg-Essen): HCI Frames

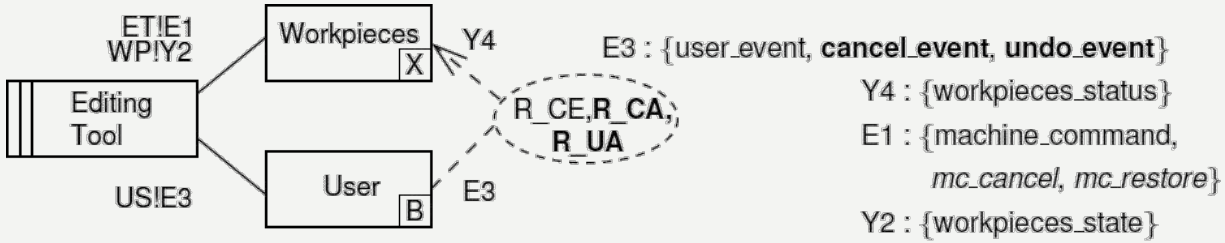
- Problem Frames (M. Jackson): splitting up a problem into instantiations of well-known basic problem categories



Problem frame diagram for "Simple Workpieces"

[SW07]

- Amended to incorporate usability principles



*HCI*Frame for "Simple Workpieces" (additions in bold face and italic type)

- Stakeholders required to learn formal language, adopt way of thinking

Bass (CMU)

General usability scenarios

- Interactions, Examples
- Incomplete

Usability Scenario: Canceling a Command
The user issues a command, then changes his or her mind, wanting to stop the operation and return the software to its pre-operation state. It doesn't matter why the user wants to stop; he or she could have made a mistake, the system could be unresponsive, or the environment could have changed.

[BJK01]

Rafla (Polytechnique Montréal): U-QAW

QAW: Quality Attribute Workshop (CMU),
can be used with ATAM

U-QAW: usability-driven adaptation

…

Step 4: Scenario brainstorming
Users learn, exercise and use usability properties (Folmer) and general scenarios (Bass)

...

Step 7: Scenario refinement
Usability analysts examine scenarios, write use cases

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Approach

Zhu (University of New South Wales): Extracting quality attribute scenarios from architectural patterns

Diploma thesis: Extracting usability scenarios from usability patterns

Sources

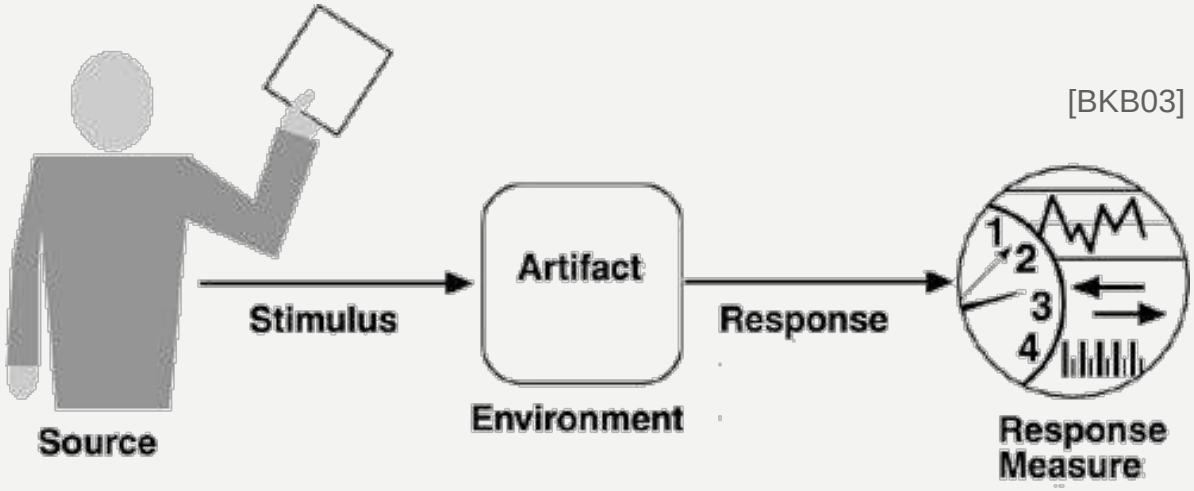
Patterns, pattern stubs/outlines, best practices and alike by Tidwell, Folmer, Bass, Little Springs Design, Juristo

Additional scenarios and scenario improvements possible through exploitation of further sources

Scenario Structure

Bass (CMU):

Basic structure



[BKB03]

Elements added:

- Usability patterns (detailed recommendations, examples)
- Flags for use in stationary and mobile contexts
- Architectural rating, hints, patterns
- Categorisation (bottom-up, top-down)

Rating of Architectural Relevance

- Probability of major changes to the architecture due to the "retro-fit problem"
- Used for scenario selection in architectural analysis
- Juristo: 20 architectural patterns supporting usability, gained from (changes to) software models

★☆☆☆ low
★★☆☆ medium
★★★☆ high

} estimation based on expected architectural impact

★★★★ documented in literature

Example Scenario (1/2)

ID:	4
Name:	Cancelling Commands
Source:	Users
Stimulus:	started an operation but now do not want it to be executed any longer.
Artifact:	System
Environment:	Runtime
Response:	The system immediately stops execution as users activate the cancelling option.
Response Measure(s):	Cancellation is performed and communicated to the user within a certain time span. System state before starting the operation is restored.
Static/Mobile Use:	Yes / Yes

Example Scenario (2/2)

Interaction Category/ies:	Executing, Repeating and Revoking Commands
Usability Attribute(s):	Safety, Learnability
Usability Pattern(s):	[Ti05] 50 – Cancelability Provide a way to instantly cancel a time-consuming operation, with no side effects. [BJK01] 3 – Canceling Commands Systems should allow users to cancel operations. [Fo05] 19 – Cancel Allow the user to cancel a command that has been issued but not yet completed, to prevent reaching an error state.
Architectural Rating:	★★★★

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Questions:

- Can the scenarios be well understood by non-experts?
- Are they effective and efficient in use?
- How can they be improved?
- What experimental set-ups and procedures are helpful?

Explorative Study

- Part 1: Stakeholder session (experiment, 2 groups)
- Part 2: SATURN step 2 (architecture analysis, scenario selection)

Part 1: Stakeholder Session

- Wanted: Usable interactions for a mobile photo software
- Group A: Free brainstorming
- Group B: Elicitation based on scenario catalogue (50/107)
- Questionnaires

H1: Requirements elicitation sole / in pairs using the scenario catalogue is at least as thorough as collaborative brainstorming.

H2: Requirements elicitation sole / in pairs using the scenario catalogue is at least as valid as collaborative brainstorming.

H3: Combining both methods leads to better results than exclusively using one of them.

Group A + Group B + Own Results:

- 111 total findings
- 51 hits (2 of them not in scenario catalogue)

Results Group A, Group B:

	A	B	A ∩ B
Hits	25	24	7
False alarms	2	0	0
Misses	26	27	9

Some Feedback

Group A

- **Checklist, aid to memory**
- Visualisation

Group B

- **Learning by doing**
- Categories were not used
- Few scenarios: unclear wording, similarities

Consequences

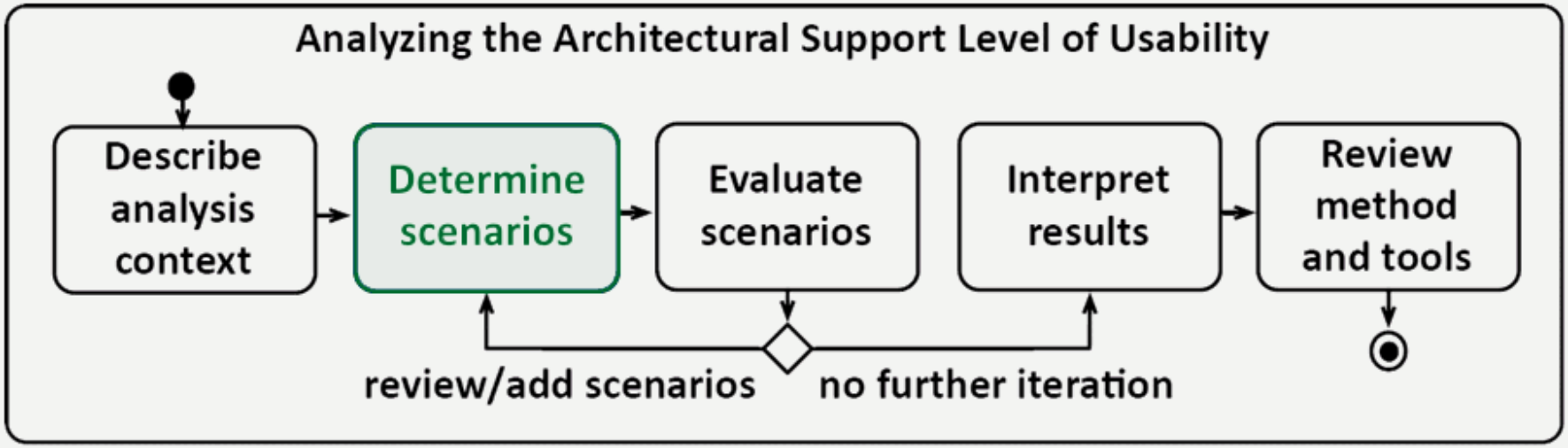
Scenarios

- Checked for overlapping content
- Some wording revised

Future (confirmatory) studies (stakeholder sessions)

- Complete catalogue to be used
- Brainstorming and scenario-based elicitation to be executed consecutively by the same group
- More representative participants
- Multiple runs
- Time + space ...
- Scenario use: example instead of explanations

Part 2: SATURN Step 2



[Bi09]

- Mobile application: “ADAC StauScanner”
- 2 analysts, 1 software architect
- 42 architecturally relevant scenarios in catalogue

Results

- 12 scenarios selected during session (1 modified)
- 5 “very important”, 6 “important”, 1 “less important”
- 1 scenario with incorrect wording
- Remaining scenarios immediately understood

Consequences

- 1 scenario revised
- 1 scenario added to catalogue

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Results Interpretation

- More findings using complete catalogue? H1, H2 (higher thoroughness, validity) correct? → Full study.
- Scenarios generally well understandable; intuitive use (few misconceptions, observed learning by doing)
- Apparently important contributions to requirements engineering and architecture analysis
  (part 1: 17 findings due to scenarios only;
  part 2: 11 out of 12 selected scenarios at least important)
- Consecutively carried-out brainstorming and scenario-based elicitation likely to result in more hits (here: 42) than sole use of one method (H3)

[Bi09]	Bettina Biel. Towards Analyzing the Architectural Support Level of Usability. In: Working Paper Series. Social Science Research Network. 05.12.2009. http://ssrn.com/abstract=1506026.
[BJK01]	Len Bass, Bonnie E. John, Jesse Kates. Achieving Usability Through Software Architecture. Technical Report, Carnegie Mellon University, Software Engineering Institute, Pittsburgh, PA, USA, 2001.
[BKB03]	Felix Bachmann, Mark Klein, Len Bass, Paul Clements, Rick Kazman. Understanding Quality Attributes. In: Len Bass, Paul Clements, Rick Kazman (alle Hrsg.). Software Architecture in Practice. Addison-Wesley Professional, 2. Auflage, Boston, MA, USA, 2003, S. 71-98.
[Fo05]	Eelke Folmer. Software Architecture Analysis of Usability. Dissertation, Rijksuniversiteit Groningen, 2005.
[SW07]	Markus Specker, Ina Wentzlaff. Exploring Usability Needs by Human-Computer Interaction Patterns. In: 6th International Workshop on TAsk MOdels and DIAgrams (TAMODIA). Toulouse, Frankreich, November 2007, Springer, S. 254, 260.

Juristo (STATUS project)

- Guidelines for eliciting usability functionalities
- 20 architectural patterns supporting usability gained from changes to a software model to support specified usability patterns

Schmettow (Fraunhofer IESE / University of Passau)

Pattern-based usability inspection

- need for a method for efficient usability evaluation by non-experts (software developers in small and medium-sized companies)
- collection of usability patterns by Tidwell, van Welie etc.
- “downstream utility”
- bottom-up criteria used for pattern search (interactions, dialogue context)

Extracting Usability Scenarios (Zhu)

Problem part → stimulus, source of stimulus, environment

Solution part → response, artifact

Example:

- Data Transfer Object pattern
- Scenario: „A periodic large amount of data requests *(stimulus)* from an independent source *(source of the stimulus)* arrive at the system under normal condition *(environment)*. The system *(stimulated artifact)* has to transfer the data *(response)* within a certain amount of time under a certain network limit *(response measure)*.“

Extracting Usability Scenarios (Diploma Thesis)

Pattern „Cancelability“ (Tidwell):

What	Provide a way to instantly cancel a time-consuming operation, with no side effects.
Use When	A time-consuming operation interrupts the UI, or runs in the background, for longer than two seconds or so – such as when you print a file, …
Why	Users change their minds. Once a time-consuming operation starts, a user may want to stop it, especially if a Progress Indicator tells …
How	…
Examples	…

Vergleichbare Patterns bei Bass („Canceling Commands“), Folmer („Cancel“)

Szenario: „Users started an operation but now do not want it to be executed any longer. The system immediately stops execution as users activate the cancelling option.“

Bottom-up Categories

Users' perspective, interaction-oriented

Defined so far:

- Acquiring and Processing User Input
- Orientation
- Navigating/Browsing/Choosing
- Executing, Repeating and Revoking Commands
- Using an Unfamiliar System
- Data Selection and Exploration
- Processing Graphics and Graphical Objects
- Data Exchange and Manipulation
- Information Retrieval
- Structuring and Displaying Content/Information/Data
- Error Handling and Help
- Adaptation (by Users/to Users/ for Tasks)
- Exchange/Cooperation Within and Between Systems

Top-down Categories

Quality model perspective (usability attributes)

Usability goals by Preece:

- Effectiveness
- Efficiency
- Safety
- Good Utility
- Learnability
- Memorability

Comparative Thoroughness, Validity

$$Thoroughness = \frac{no.\,of\ hits}{no.\,of\ total\ possible\ hits}$$

$$Validity = \frac{no.\,of\ hits}{no.\,of\ hits + no.\,of\ false\ alarms}$$

	A	B
Thoroughness	0,490	0,471
Validity	0,926	1,000