

# Towards Systematic Usability Evaluations for the OR: an Introduction to OR-Use Framework

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## Motivation

- Complexity in the health care environment has increased due to complicated technological equipment
- Deficiencies in the design of medical technology can increase the risk of human error
- 44,000 to 98,000 people die each year from preventable medical errors (adverse errors) in the U.S. [1]
- 60% of adverse events are caused by use errors, therefore wrong usage of technical equipment is considered as the main reason for adverse events in medicine
- Complexity of the medical domain aggravates the work of usability specialists [2]

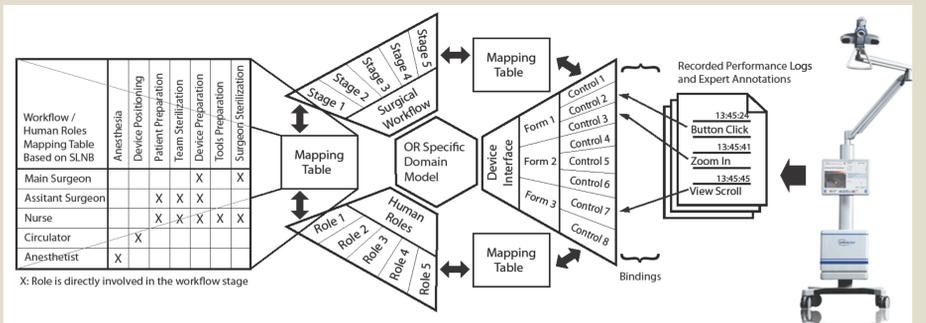
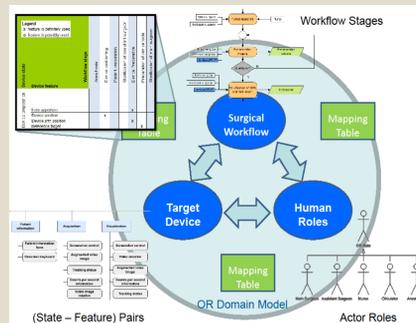
## Background

- Usability study is aiming at improving the usefulness of a device for its specific end users
- The OR is a complex domain which has characteristics like open-ended and unstructured problems, extensive domain knowledge for actors, information overload and critical timing
- Planning, conduction, analysis and interpretation phases of the usability engineering processes in complex domains are challenging [3]
- Unlike many other domains, such as mobile applications and websites, there is no specific tool to support usability testing for the operating rooms

## OR Specific Domain Model and Binding of Usability Data

### Our approach:

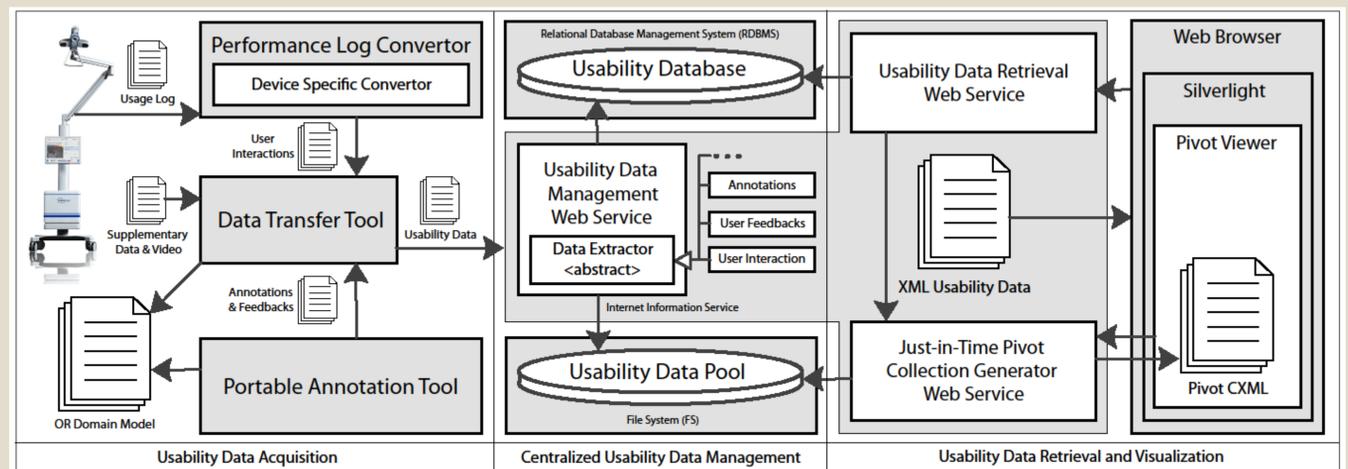
- We developed a framework to support usability testing in the OR
- Based on the OR specific domain model, introduced in [4]
- Wide range of usability data can be collected and stored with a direct connection to the complexity aspects of the OR domain



## Architecture of OR-Use Framework

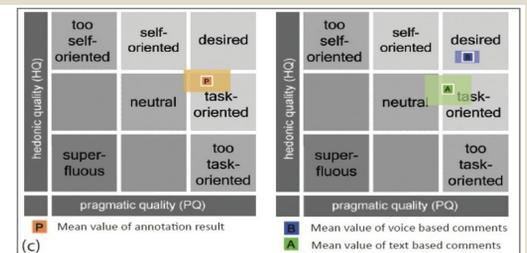
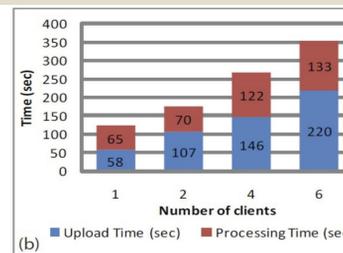
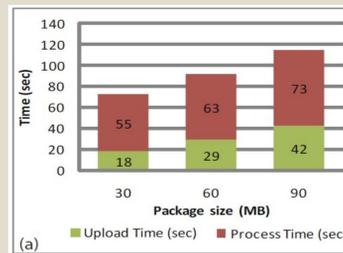
### Main functionalities:

- Usability data acquisition
  - Extensible model for recording data from various devices
  - Portable on-site annotation tool
  - Secure data transmission
- Centralized data management
  - Support for multi-center studies
  - Extensible data extraction
- Data retrieval and visualization
  - Support for analysis
  - Flexible data query language
  - Web-based visualization interface



## Quantitative and Qualitative Evaluations

- Until November 2011, the OR-Use is used in 12 user studies and 7 surgeries
- More than 2000 user interactions and 163 feedbacks have been collected, using thinking-aloud technique
- Uploading and processing time with data of 30, 60 and 90 MB size in 3 different test sessions, lasting about 15 minutes
- Running on a 2.5 GHz Intel Core 2 Duo machine with 4 GB of memory connected via a shared wireless network



(d) Functionalities	M	WBT	WBX	HUA	WUP	SAV	ORU	Legend:
Workflow/Task modeling	X	X	X	X	X	X	O	I = Implemented
Multiple roles	X	X	X	X	X	X	I	O = Achieved to some extent
Device model	X	X	O	I	O	X	O	x = Not supported
Performance logging	I	I	X	I	I	I	I	M = Morae
Observers annotations	I	X	X	X	X	I	I	WBT = Web based tool
Video & supplementary materials	X	X	X	X	X	I	I	WBX = WebXACT
Configuration management	O	O	O	O	O	O	I	HUA = HUIA
Data retrieval	I	I	I	I	I	I	I	WUP = Web Usability Probe
Video indexing	X	X	X	X	X	I	I	SAV = SAVE
Visualization	I	I	O	I	O	O	I	ORU = OR-Use

## Selected References:

- [1] Kushniruk et al. Cognitive and usability engineering methods for the evaluation of clinical information systems. JBI, 37(1):56-76, 2004.
- [2] Liljegren. Usability in a medical technology context assessment of methods for usability evaluation of medical equipment. IJIE, 36(4):345-352, 2006.
- [3] Chilana et al. Understanding usability practices in complex domains. 28th Int. conf. human factors in computing systems, ACM, 2337-2346, 2010.
- [4] Bigdelou et al. OR specific domain model for usability evaluations of intra-operative systems, IPCAI 2011.