

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]

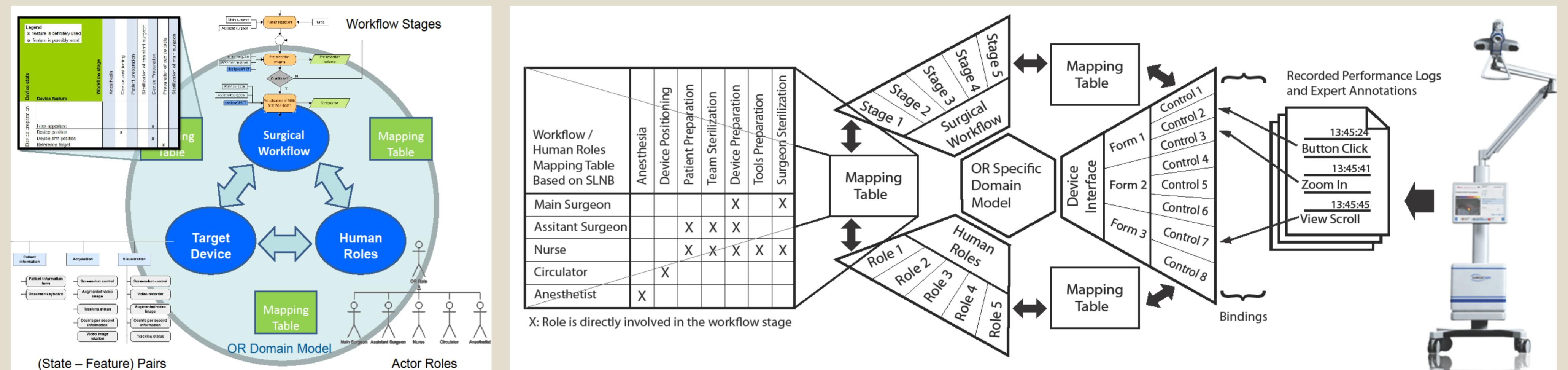
Background

- 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:

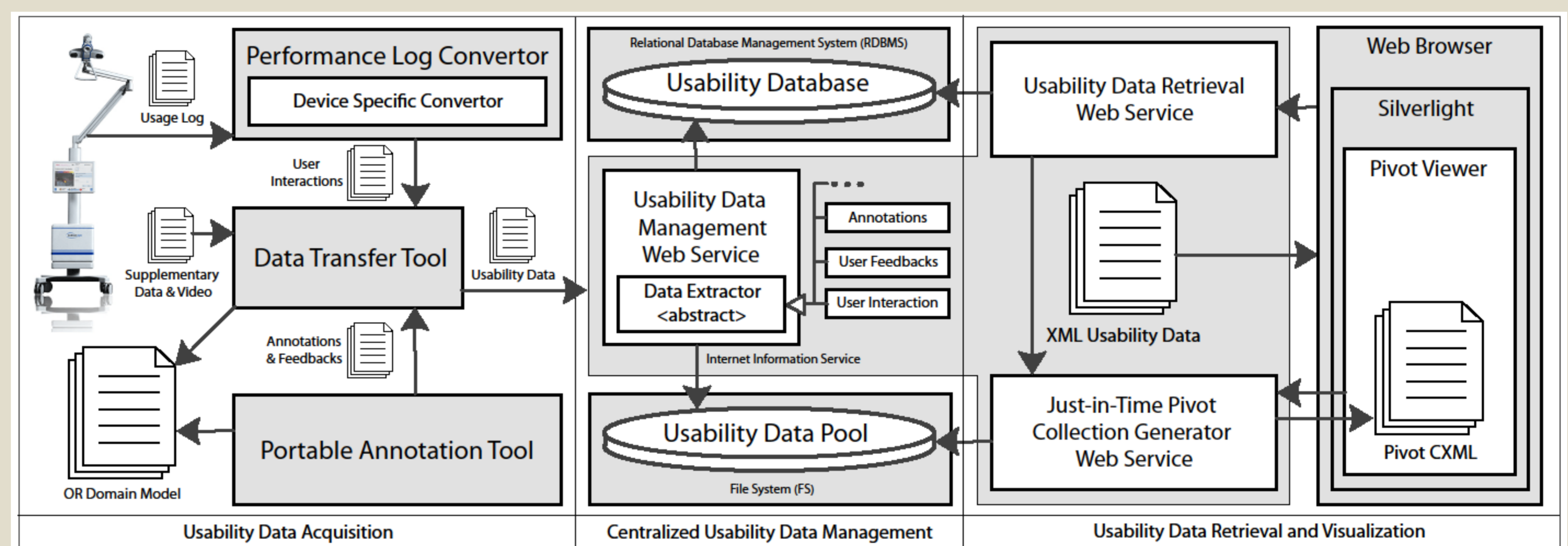
- We developed a framework to support usability testing in the OR
- Based on the OR specific domain model, introduced in [4]
- Wide range of usability data can be collected and stored with a direct connection to the complexity aspects of the OR domain



Architecture of OR-Use Framework

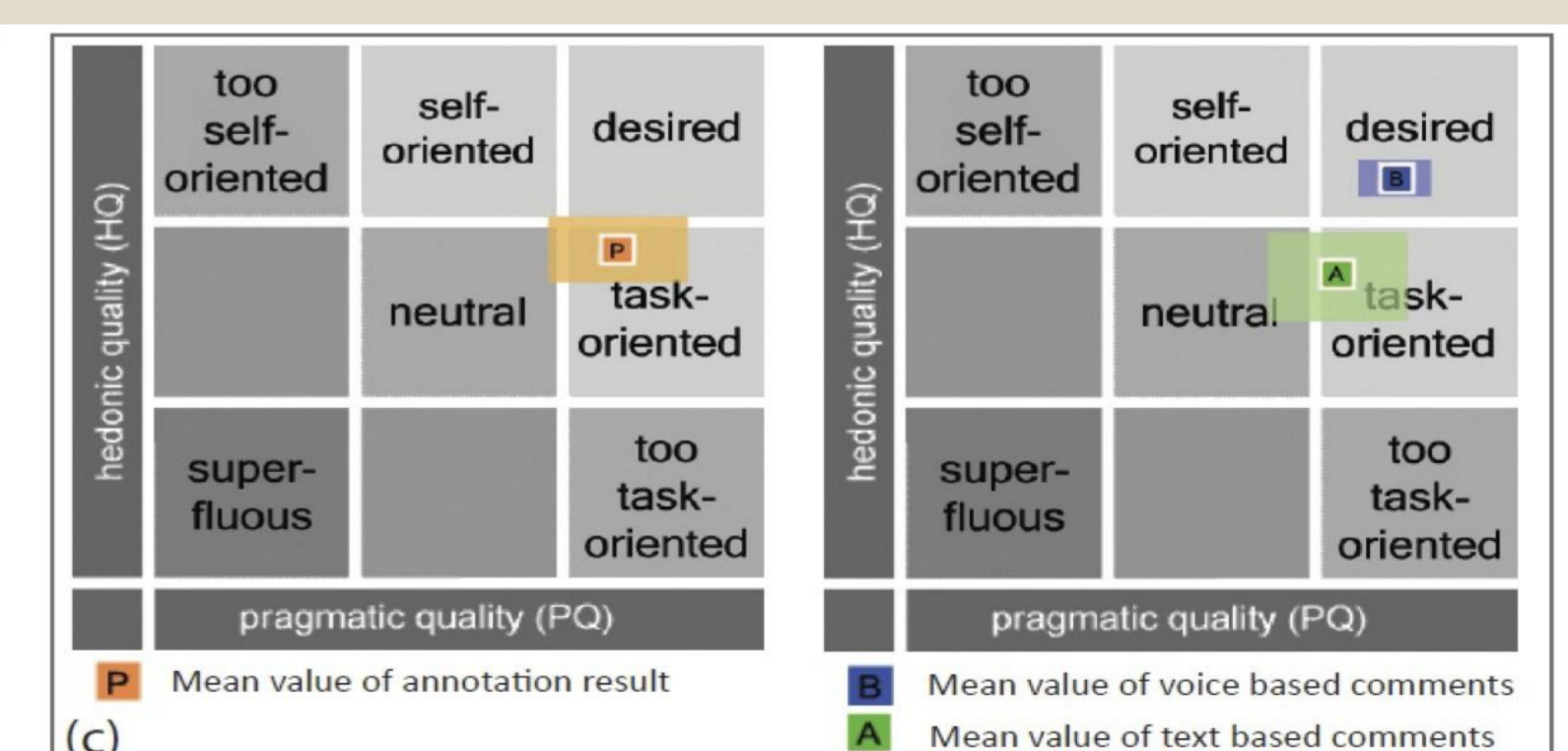
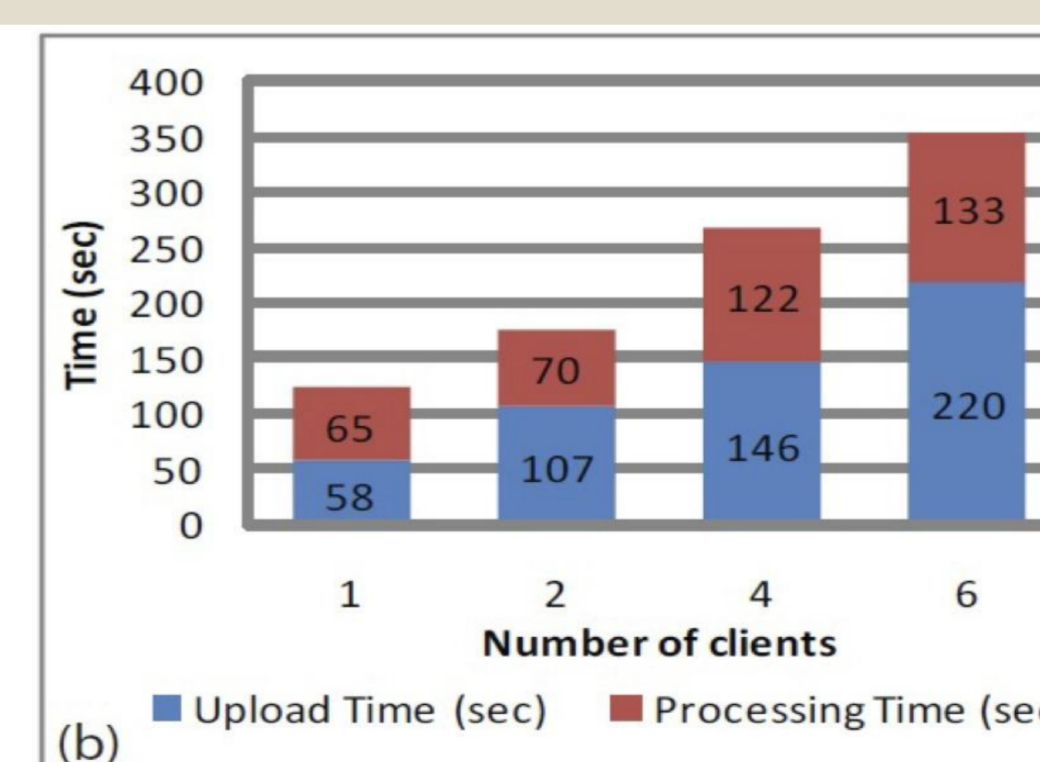
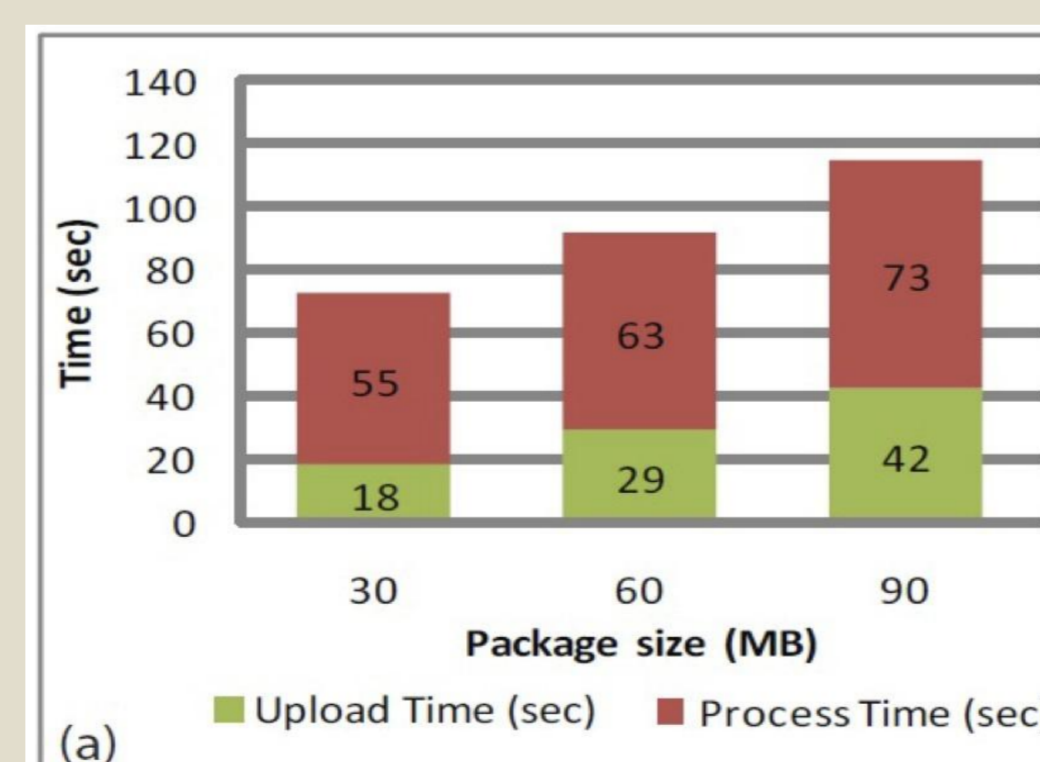
Main functionalities:

- 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:

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