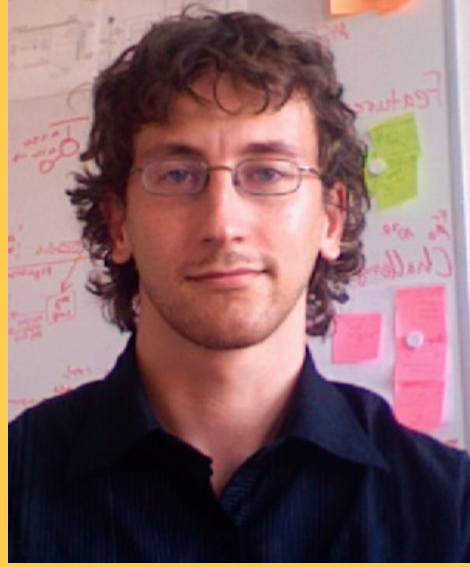


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Holger Giese  
HPI  
System Analysis and Modeling



Gregor Gabrysiak  
HPI  
Requirements Validation



Andreas Seibel  
HPI  
Tracability of Requirements



Mathias Weske  
HPI  
Business Process Technology



Alexander Großkopf  
HPI  
Process-Based Collaboration

# Scenario-Based Prototyping for Designing Complex Software Systems with Multiple Users

## The Need

Extracting and condensing end user knowledge is a critical part in software requirements engineering. Project budgets do not allow excessive validation of what has been elicited before. A false understanding upfront can lead to expensive mistakes in each software project. Therefore, a correct shared understanding needs to be established and validation of the as-is situation is crucial. There is a need to validate requirements with end users and gather their feedback.

## Our Idea

We conceptualized a simulation environment in which end users can experience working procedures. It reproduces the processes that were extracted by the user researchers. The end user can experience the business process as understood by the user researchers. This tangible simulation, generated from a conceptual software model, enables the end users to provide additional feedback and identify misunderstandings. The user feedback is collected during the simulation and can be used for qualitative and quantitative analysis of the understanding.

## The Use Case: D-LABS

D-LABS is a consulting company that uses user-centered design and design thinking principles. These approaches help them to identify end user needs

and find extension points of existing software systems and services. Their customers are, among others, software vendors that want to understand how they can extend their tools and services while increasing user satisfaction. D-LABS typically delivers a set of insights derived from qualitative end user research, a solution concept and a software prototype. The prototype created along the way embodies the conceptual ideas and are used to test these ideas with the end users.

## The Tool Chain

We adopted the way D-LABS works in their synthesis phase. Activities are derived from storytelling and clustering. This information can be uploaded into our tool, see figures below. We generate modeling artifacts similar to pieces of a jigsaw puzzle. The user researchers can arrange them to build a process model representing the initially elicited working procedures. It captures roles, work packages, dependencies, decision points, handovers, and documents. We use the model as an input for our simulation environment. The end user is invited to use the simulator to validate the process elicited so far and provide feedback. Since many people and roles can be involved in a process, our tool simulates the context accordingly for each role. The input of each user can be used as case data for subsequent sessions. Based on this re-use of recorded interactions, the simulation becomes more and more realistic.

All the user interactions are traced. Thus, we know how users actually behaved during the execution of the claimed process. The captured information (including individual feedback) can be analyzed

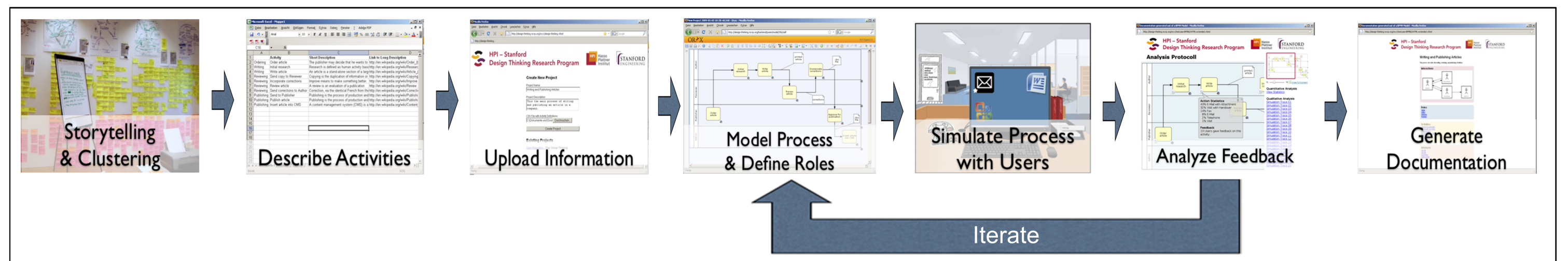
quantitatively (How many users chose e-mail over telephone to complete a particular task?) and qualitatively (Which shortcuts were used in the fastest process execution?).

Diving into individual process instances plus evaluating statistics of overall use provides the user researchers with new insights. This leads to changes of the model. By using the same validation approach for this adapted model, we enable the iterative improvement of the initially elicited process. The approved process can be used to generate documentation as input to the subsequent software engineering project.

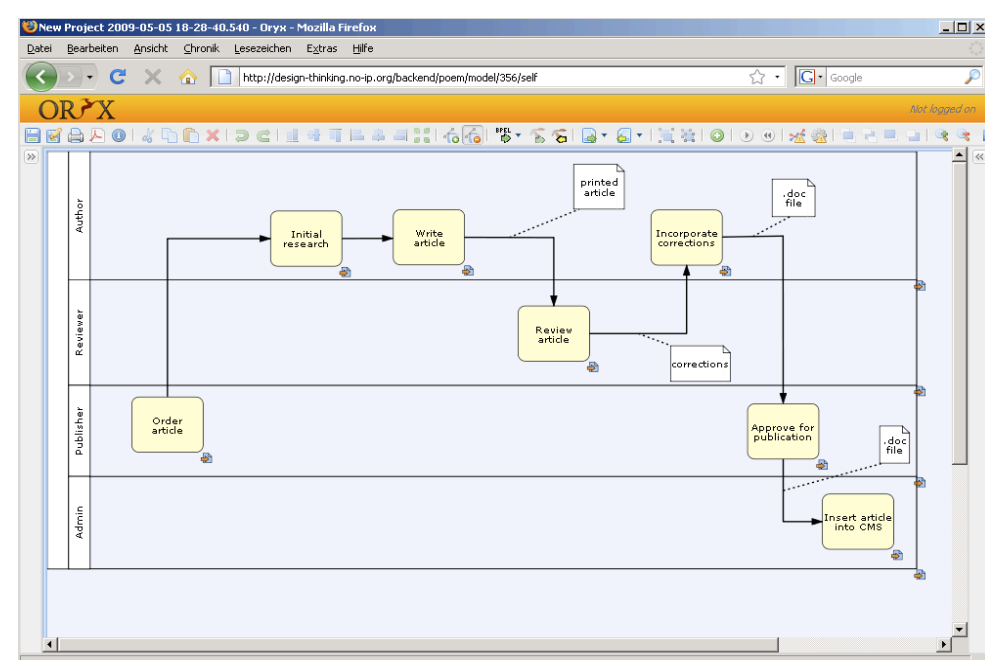
## Learnings and Future Directions

During the first year of the Design Thinking Research Project, we learned that the validation of end user requirements is crucial. The way information is presented to the user determines the feedback that can be gathered. We learned that our representation encourages more detailed feedback to individual steps. To further investigate how the feedback changes based on the presentation, we created a software prototype. In the year to come, we want to cover the following points:

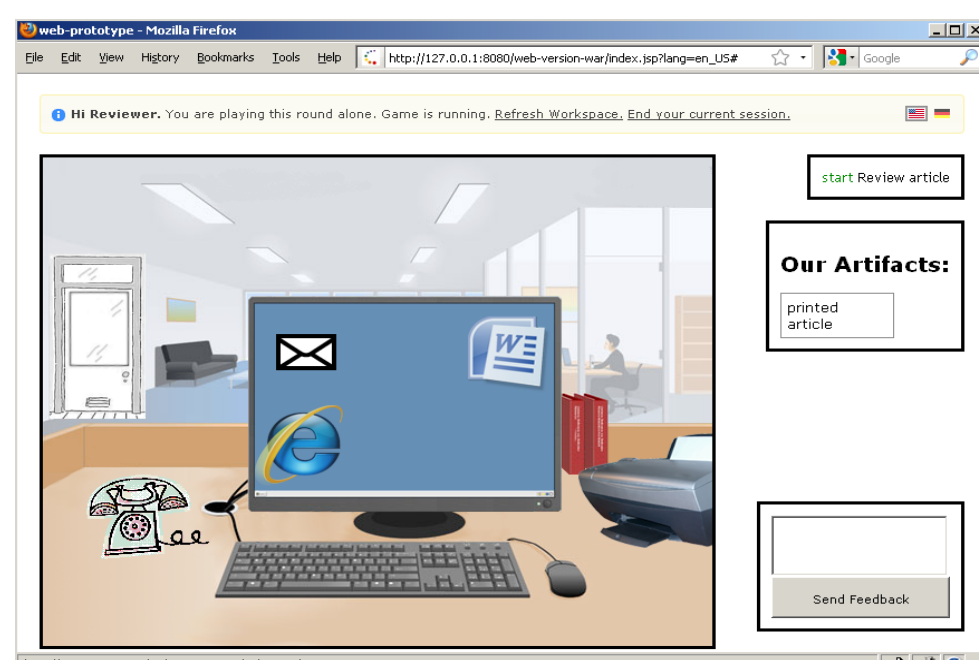
- Implementation of other visualizations
- Automated changes to the model based on feedback
- Industry projects to evaluate our concept in a realistic environment
- Compare cost-effectiveness to other validation methods
- Which visualization proves most suitable for which group of stakeholders?



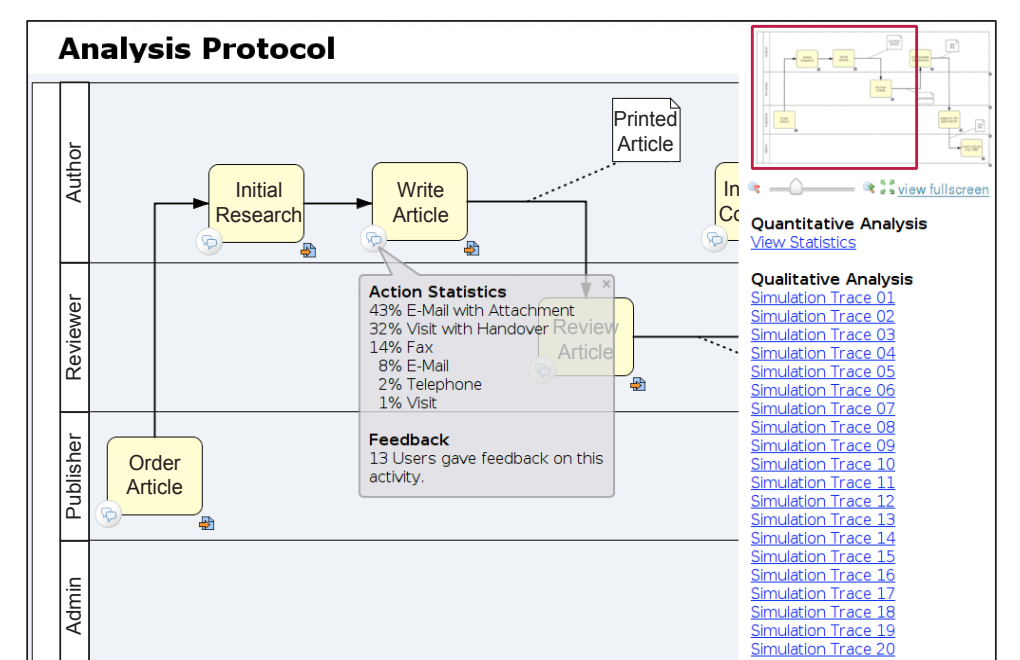
Our tool chain integrates with D-LABS' design process, which is Design Thinking adapted to the needs of software development. By enabling end users to provide feedback during the simulation, corrections can be elicited and fed back into the model. Through iterations the underlying models can be improved to fit the real needs of the end users. This promises to be more cost effective than existing requirements validation techniques.



After initial interviews a first model of the process and the participating roles can be created. Based on feedback about the current model, the process and the role definitions can be modified accordingly.



During each session, end users can experience the current model through an animated interactive simulation. The users interact with each other or simulated participants through domain specific communication channels.



After each session, the traces can be visualized. This enables qualitative and quantitative analysis of what was done during multiple sessions. Combined with comments, necessary changes to the model become obvious.