HOLISTIC HUMAN FACTORS AND SYSTEM DESIGN
OF ADAPTIVE COOPERATIVE HUMAN-MACHINE SYSTEMS

Human Efficiency Evaluator

Motivation

The Cognitive Analysis of Adaptive Cooperative Systems (AdCoS) depends on complex architectures and simulations and is still driven by proprietary notations. Model creation requires in-depth expertise in cognitive modelling and is currently only accessible to experts.

New methods and techniques are therefore needed in order to analyse the impact of new instruments, new display designs or their adaptations with respect to human factors. Typical design questions to be answered are:

- How does *the task execution performance* of the operator change with each adaptation?
- How do the *attention distribution* of the operator change?
- How fast can the operator react to *unexpected events*?
- Is the *workload* of the operator affected?
- Have all *important aspects* been considered in the design?

These questions can be answered by applying a model-based approach for Human Machine Interface (HMI) evaluation in early design phases:

- Selection of re-usable instrument and display designs from domain specific repositories.
- Creation and Evaluation of new display/instrument designs.
- Evaluation of different system designs based on photos, screenshots or sketches by computer simulation of the models/prototypes, including a model for the human behaviour (cognitive architecture).

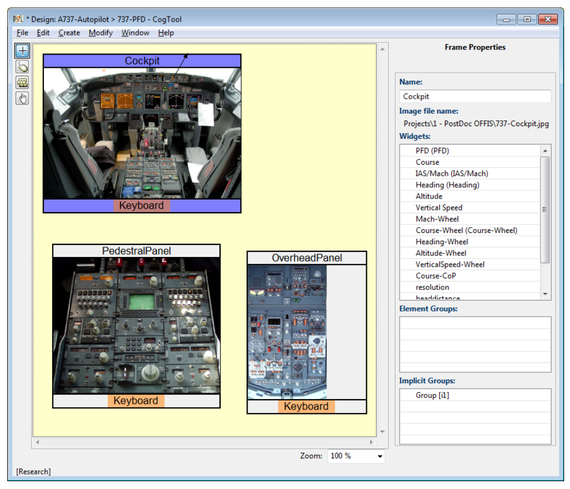
Methods, Techniques, Tools

This is a …	☐ Method	☐ Technique	☒ Tool
Method	Cognitive Ergonomics		
Technique	Modelling & Simulation		
Tool	Task Editor, Usability Evaluator, CASCaS		

Tool Chain

The OFFIS Modelling Tool Chain consists of several tools: **A Task Editor** to identify interaction tasks between the operator and system. The **Human Efficiency Evaluator** to model the interaction capabilities of the environment, to demonstrate procedures for common tasks and to execute **CASCaS**, a cognitive architecture for prediction of human behaviour, allowing analysis of **Human Factor Metrics**.

AdCoS Annotation

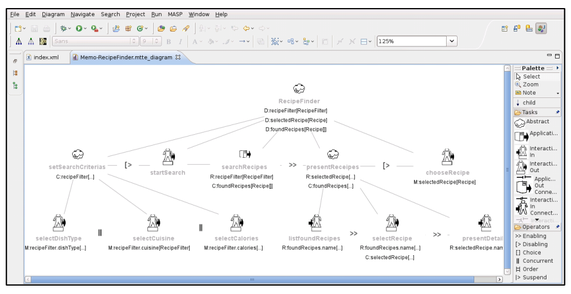


1.

Photos of the AdCoS

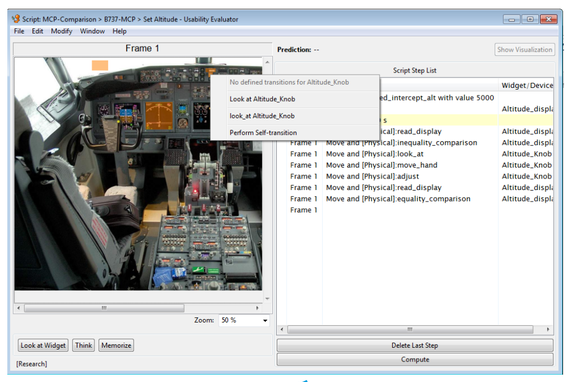
2.

Task Editor



3.

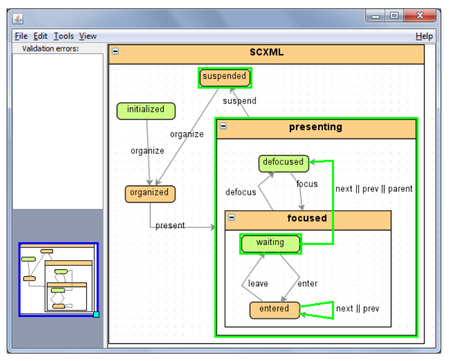
Operator Procedure Creation by Demonstration



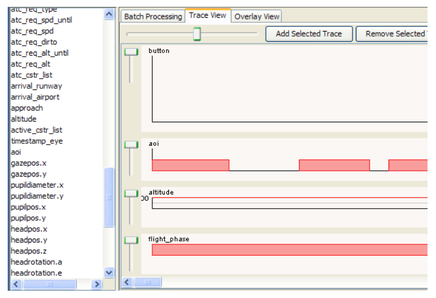
4.

5.

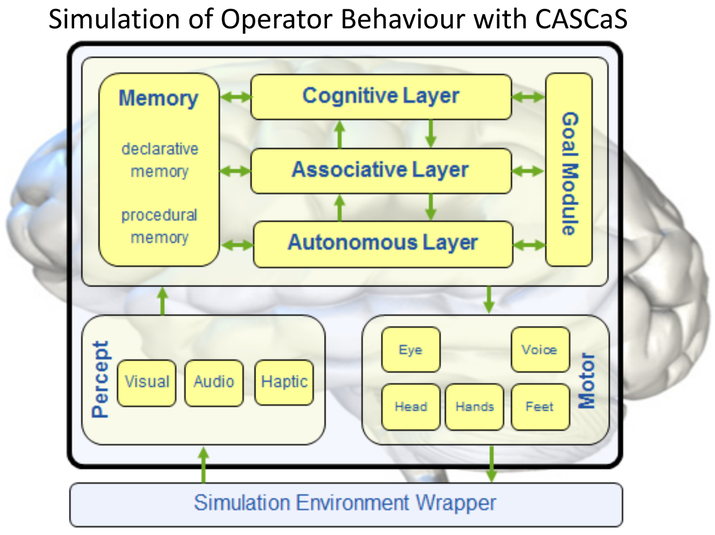
6. Displays and Instruments Repository



Detailed Logging of the Operator's Cognitive Processes



Simulation of Operator Behaviour with CASCaS



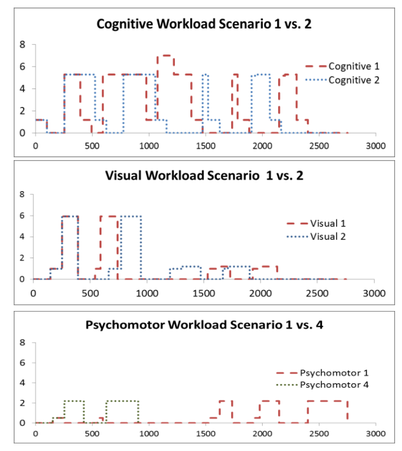
HF Metrics

HF Metrics define the comparisons to be applied for analysis of different versions of a new system, or with a baseline.

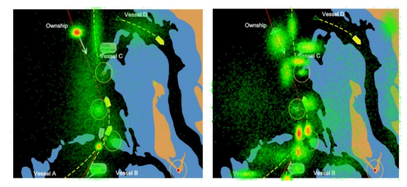
Task Execution Time

Tasks	MD80	B737
Mental Arithmetics Flaps Set	4,391.0 s	
Speed Card Flaps Set	3,747.0 s	
Speed Bugs Flaps Set	3,428.0 s	
Primary Flight Display		1,114.0 s

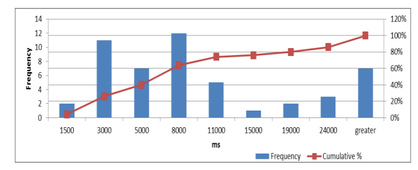
Workload Predictions



Attention Distribution

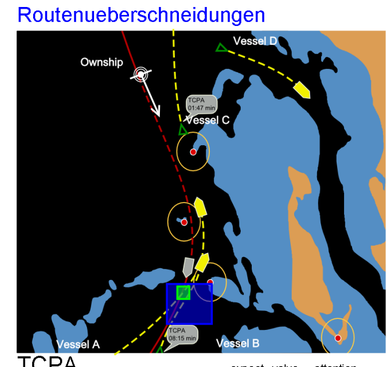


Average Reaction Time



Design Coverage

Routenueberschneidungen



Video

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Consortium

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