

# A model based approach to Cognitive Work Analysis and work process design in air traffic control

---

*Christoph Möhlenbrink, Hendrik Oberheid, & Bernd Werther  
German Aerospace Center (DLR)  
Braunschweig, Germany*

## **Abstract**

In the DLR (Deutsches Zentrum für Luft und Raumfahrt) project RApTO<sub>r</sub> (Remote Airport Tower Operation research) new working processes for air traffic controllers will be designed. As a basis for this development a cognitive work analysis (CWA) was conducted of the presently existing work environment and decision processes at Leipzig airport. Understanding decision making in such highly complex and dynamic environments with multiple competing goals is generally a difficult endeavour. A cognitive work analysis is a possible approach to investigate the environmental and cognitive constraints of the operator. However, in the work domain of air traffic control timing plays a crucial role and cannot be neglected. In fact, the operators' task can only be understood when time-critical and causal interdependencies are analyzed. From the authors' point of view it is not the task of a CWA itself to look at time-critical and dynamic dependencies, but model based approaches have to address this issue. With executable models specific scenarios can be simulated, analyzed and discussed with respect to temporal and causal dependencies. A human-machine-model is needed to be able to analyze the reciprocal interdependencies of an air traffic controller's task and the dynamic processes on the airport.

In line with Cacciabue's approach the model consists of a human-model, a machine model (process-model) and an interaction model. The paper introduces how the results of the CWA are transferred into the executable human-machine-model FAirControl, realized with coloured petri nets. Such models allow formal verification by graphical state space analysis.

The controller model (PG-Model) and the airport process model (AP-Model) are represented as resource limited systems. More assumptions for both models are specified. The tool FAirControl contains a visualisation of the airport processes and a user-interface to be able to investigate work process design by human-in-the-loop-experiments.

The authors suggest a formal state space analysis to identify multiple task situations. These situations for the controller are determined by the timing constraints implemented in the model. An example is given, that contrasts a controller-model with limited resources (timed) to a controller-model with unlimited resources