HoliDes

Holistic Human Factors **Des**ign of Adaptive Cooperative Human-Machine Systems

D2.1 – Requirement Analysis for Modelling Techniques and Tools

Project Number:	332933
Classification:	Public
Work Package(s):	WP2
Milestone:	M1
Document Version:	V0.1
Issue Date:	09.04.2014
Document Timescale:	Project Start Date: October 1, 2013
Start of the Document:	Month 05
Final version due:	Month 06
Deliverable Overview:	**Main document**: D2.1 Requirements Analysis for Modelling, Public **Annex I**: Requirement Overview, Public
Keywords:	Requirements, Analysis, Modelling, Simulation
Compiled by:	Jan-Patrick Osterloh, OFF
Authors:	Jan-Patrick Osterloh, OFF
Technical Approval:	Jens Gärtner, Airbus Group Innovations Daniel Prun, ENAC
Issue Authorisation:	Sebastian Feuerstack, OFFIS

DISTRIBUTION LIST		
Copy type[1]	Company and Location	Recipient
T	HoliDes Consortium	all HoliDes Partners

[1] Copy types: E=Email, C=Controlled copy (paper), D=electronic copy on Disk or other medium, T=Team site (Ajaxplorer)

RECORD OF REVISION		
Date	Status Description	Author
17.03.2014	Initial Version	JPO
31.03.2014	Update	JPO

Table of Contents

1 Introduction

This document describes the first results on the analysis of requirements, which have been collected from the application work packages (WP6 Health, WP7 Aeronautics, WP 8 Control Rooms and WP9 Automotive) regarding their relevance for human factor modelling techniques and tools. It will describe, which techniques and tools will be used within WP2 for the HF RTP v.0.5, how the requirements have been analysed and which requirements are relevant for WP2. Furthermore, this deliverable will be input for several other WP2 tasks and Deliverables, e.g. D2.2 (Plan for Integration of Model-based Analysis Techniques and Tools into the HF-RTP and Methodology) and the HF RTP versions.

2 Background

2.1 Human Factors Modelling Techniques and Tools

WP2 will develop modelling techniques and tools for all components of Adaptive cooperative Human-Machine Systems (AdCoS) in order to formalize the capabilities and strategies for dynamic adaption of the overall systems and a global and local level. Figure 2-1 shows the tasks and the structure of WP2, as well as the interdependencies of WP2 with the other WPs. From WP1, the initial version of the RTP will be delivered to WP2, including the requirements from the AdCoS WPs. These requirements will be analysed in T2.1. In the MTT tasks (T2.2-T2.6), the requirements will be used to develop models for describing the different aspects of an AdCoS, i.e. models for tasks, resources, cooperation, human operators, HM interaction and training. These models will be integrated into a Common Modelling Framework in T2.7, and the tools developed for the models, will be integrated into the HF-RTP in T2.7. This will then be delivered to the other WPs for application and further development.

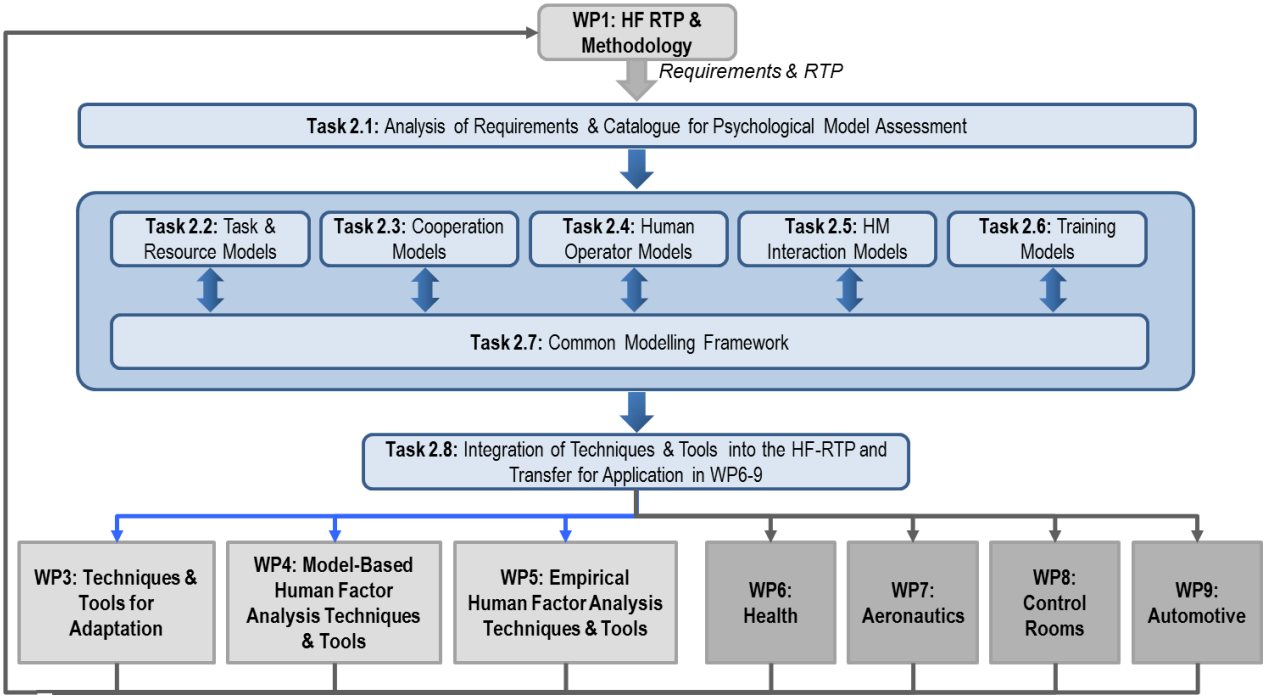

Figure 2-1: WP2 tasks and structure

2.2 Provided Methods, Techniques and Tools

As a first step, the techniques and tools which are a) brought in as background from the different WP2 partners, and b) the tools that we are developing in WP2 specifically for HoliDes have been collected. In this first step, 15 tools and associated techniques have been identified to be relevant for WP2 for the first HF-RTP version. For these tools, which are listed in the following table, requirement will be assigned:

Task	Partner	Tool name	Tool type	Short description	Main features	Potential users (WPs)	Tool maturity
T2.5	ENA	Djnn	GUI programming toolkit	Djnn intends to provide a model-based toolkit for the development of innovative post-WIMP graphical user interfaces.	GUI programming toolkit	WP4	Under development
T2.1, T2.4, T2.8	IFS	COSMO-SIVIC	Driver model and virtual simulation tool, to support a Human Centred Design approach of Driving Aids	COSMO-SIVIC is a simulation research tool designed during the ISI-PADAS project (2008-2011), integrating a Driver model (named COSMODRIVE for COgnitive Simulation MOdel of the DRIVEr) able to drive a virtual car into a virtual environment (based on a SiVIC pre-commercial version of ProSIVIC). During the HOLIDES project, it is expected to interface this research tool with ProSIVIC and RTMaps, in order to support virtual simulation of future AdCoS use by human drivers (as assessed via COSMODRIVE). COSMO-SIVIC can be also used as a driving simulator, for implementing experiments and tests among real human drivers.	Driver model (with a virtual eye and cognitive abilities) able to dynamically pilot a virtual car in a 3D road environments (provided by SiVIC/ProSIVIC platform). From the development to be done during HOLIDES, to be interfaced with an AdCoS implemented and simulated via ProSIVIC and RTMaps tools	WP4, WP9	Research tool to be used and developed by IFSTTAR during the HOLIDES project (in interaction with CIVITEC and INTEMPORA). Will be one of the "WP9 Demonstrator" (as a "Virtual Human Centred Design Platform" of AdCoS).

Task	Partner	Tool name	Tool type	Short description	Main features	Potential users (WPs)	Tool maturity
T2.3	IFS	„HMFDIM“	human monitoring function development and interaction modelling	Monitoring functions based on State-Transition graphs (e.g. Sateflow) and Eye-Tracking technics, in charge to observe visual scanning and critical behaviours of COSMODRIVE model in case of visual distraction. These Monitoring Functions (to be developed IFSTTAR in T2.3 and WP3) will be integrated into a virtual AdCoS to be simulated on COSMOSIVIC (done by IFSTTAR in WP4). Then, from these two complementary modelling works, is expected to use the enhanced COSMOSIVIC tool to simulate human interaction with the AdCoS		WP4, WP9	To be designed and developed during HOLIDES
T2.2	OFF	PED	Task Model and Specification	PED is a tool for graphical modelling of tasks, which can be used with CASCaS. It will be extended for handling of Training models	task modelling, hierarchical task analysis, graphical editor	WP4, WP6 WP7 WP 8 WP 9	Deployed and used outside owner's organization
T2.4	OFF	CASCaS	System/HMI evaluation	CASCaS is a fully-equipped cognitive architecture, build on psychological and physiological sound models of human behaviour. Purpose is to provide developers with a tool, allowing evaluation of a design in early development phase	cognitive architecture, human behaviour simulation	WP4, WP6 WP7 WP 8 WP 9	Used internally

Task	Partner	Tool name	Tool type	Short description	Main features	Potential users (WPs)	Tool maturity
T2.2, T9.3	OFF	Bayesian Autonomous Driver Mixture-of-Behaviours (BAD MoB) models	Probabilistic Model	BAD MoB models are hierarchical and modular probabilistic driver models that shall be used for online driver state assessment and intention prediction in driver assistance systems	Probabilistic human behaviour models, Online-adaptation of model parameters, machine-learned from multivariate time series of human behaviour traces	WP9	Under development
T2.2, T2.4	OFF	Usability Evaluator	Software	The tool supports modelling of Human Operator procedures "by demonstration" using interface photos of prototypes or existing HMIs to evaluate the interface usability based on a cognitive operator simulation.	Evaluates Human Operator Performance based on a Simulation with a Cognitive Architecture	WP4, WP8	Under specification
T2.6	OFF, TRS	"TrainingsManager"	Adaption of Training Syllabi	The TrainingManger will allow shorter transition training from one aircraft to another	training model, adaption	WP7	Under specification
T2.4, T3.3	SNV	Tobii glasses	human monitoring tool	mobile wearable eye-tracker + dedicated software for eye-tracking data analysis		WP4, WP8, WP9	
T2.4, T3.3	SNV	FaceLab 5 + Eyeworks software	human monitoring tool	desktop eyetracker + Eyeworks software for experiment design and analysis		WP4, WP8, WP9	
T2.4, T3.3	SNV	Captiv T-sens sensors + Analysis software	human monitoring tool	bio-sensors for detecting subject emotional reaction as skin-conductance, heart rate measurements tool, etc. + data analysis software		WP4, WP8, WP9	

Task	Partner	Tool name	Tool type	Short description	Main features	Potential users (WPs)	Tool maturity
T2.4, T3.3	SNV	Enobio	human monitoring tool	wearable and wireless electrophysiology sensor system for the recording of EEG		WP4, WP8, WP9	
T2.4 & T7.3	TEC	HS-SEARCHOPT	Software	HS-SEARCHOPT is a theoretical framework aimed at inferring search strategies based on captured behavioural traces of different users. This permits to predict their behaviour when handling the interface at hand. It can be extrapolated to other HMI processes (not necessarily searching)	A Harmony Search heuristic modular approach for inferring human operated search strategies	WP6 WP7 WP 8 WP 9	Under development
T2.3, T2.4, T2.8, T4.2, T4.4,	UTO	GreatSPN	Software framework	GreatSPN is a suite of tools for modeling, validation, optimization, and performance evaluation of complex systems using Generalized Stochastic Petri Nets and their extensions such as, for instance, Stochastic Well-formed Nets and Markov Decision Petri Nets. It provides a friendly framework to experiment with stochastic Petri net based modeling techniques and thanks to the implementation of efficient analysis algorithms. It can be used also to study real complex applications.	Modeling, validation, optimization and performance evaluation	WP 8 WP 9	Deployed and used outside owner's organization

Task	Partner	Tool name	Tool type	Short description	Main features	Potential users (WPs)	Tool maturity
Tasks 2.4, 3.2, 4.2, 5.2, 9.3, 9.4	TWT	Audio-Distraction	Algorithms / Tool	The AudioDistraction tool will be developed in this grant. It will provide standalone functionalities to estimate audio distraction levels in the driving cabin. For development it will profit largely from contextual information but also will depend on behavioural measures applied for implementing the Use-Cases. The AudioDistraction tool is intended to be adaptive to its Users.	Audi-based machine-learning, human-centred performance prediction, Correlation/ Regression Analysis, Linear/Non-Linear, Source Estimation Algorithms, Affective Computing Measures, Driving Simulation and Real-Experiments, potentially useful for a wider industrial application level (i.e. flight cabin, etc.)	WP7, WP8, WP9	To be developed

3 Requirement Analysis

3.1 Requirement Analysis Process

For the requirement analysis, we first collected and integrated all requirements in one excel table coming from the work packages WP6 to WP9:

- D6.1: Health related scenario descriptions – Vs 1.1 – 15/02/2014
- D7.1: Requirements Definition for the HF-RTP, Methodology and Techniques and Tools from a Aeronautics Perspective – Vs 1.0 – 12/02/2014
- D8.1: Requirements Definition for the HF-RTP, Methodology and Techniques and Tools from a Control Room Perspective – Vs 0.8 – 14/02/2014
- D9.1: Requirements Definition for the HF-RTP, Methodology and Techniques and Tools from an Automotive Perspective – Vs 0.1 – 14/02/2014

In addition, we collected all tools in the MTT work packages (WP1-5) in a dedicated list, and assigned them to the tasks in WP2.
Based on these two inputs, a document has been set up, where for each tool in WP2 the relevant requirements can be assigned, and their status can be assigned. For this, for each requirement, the following statuses can be given for a tool:

- **nr** (not relevant): This requirement is not relevant for the MTT.
- **need feedback**: Feedback on this requirement is needed from the originator. Next status "assigned", "accepted", or "rejected".
- **assigned**: This requirement tackles the MTT, but it is unclear if the requirement can be fulfilled. Next status will be "accepted" or "rejected".
- **accepted**: The requirement has been accepted by the tool provider, and will be implemented in one of the HF-RTP versions. Next status is "in progress".
- **rejected**: This requirement cannot be fulfilled by this tool. A comment why has been added.
- **in progress**: This requirement is currently under development. Next status is "in test".

- **in test**: The originator evaluates if the requirement is fulfilled. Next status "fulfilled" or "in progress".
- **fulfilled**: The MTT has been tested and the requirement is fulfilled

This table will also be used for tracking the current status of the requirements, in the next steps of the development.

3.2 Selected Requirements

In total, 441 requirements from the application work packages have been analysed. The list of requirements consisted of requirements dedicated to the development of the AdCoS, and for the RTP. The AdCoS requirements have been analysed, because it may be the case that also an AdCoS requirement is relevant for a WP model.

Annex I shows the assignment of the requirements to the tools.

The following table gives an overview on the current status:

Status	Total	not relevant	need feedback	assigned	accepted	rejected	in progress	in test	fulfilled
RTP req.:	174	81	22	67	13	0	0	0	0
AdCoS req.:	267	207	9	50	5	0	0	0	0
Total	**441**	**288**	**31**	**117**	**18**	**0**	**0**	**0**	**0**

In the given table, a requirement has only been counted once as e.g. assigned, also in case more than one MTT has assigned the status.

4 Conclusions

166 requirements out of the 441 requirements are relevant (incl. need feedback requirements) for WP2, and thus for the modelling languages and modelling tools developed within WP2. Not relevant for WP2 are 207 AdCoS requirements, and 81 RTP requirements, which also means that for 64 of the 267 AdCoS requirements WP2 MTTs could help in fulfilling the requirement (at least for the 55 requirements which have been assigned or accepted).

In general, further discussion is needed with the AdCoS WPs, especially on the requirements where feedback is needed.

It is important to state, that WP2 has a close relationship to WP4, where the models we define are used for evaluation, and also to WP3 where the WP2 models are used for defining the adaptation. This interdependency is not yet reflected directly in the requirements, and it is expected that in the progress of the project, further requirements are coming from WP3 and WP4 to WP2, which are more concrete to the models and tools used. Thus the table with requirements will be a living document throughout the project.