

Community Oriented Solutions to Minimise aircraft noise Annoyance

Aviation Noise Impacts Roadmap Annual Meeting,
Washington,
19th April 2011

Uwe Müller, DLR-German Aerospace Center, Cologne

COSMA's Goal

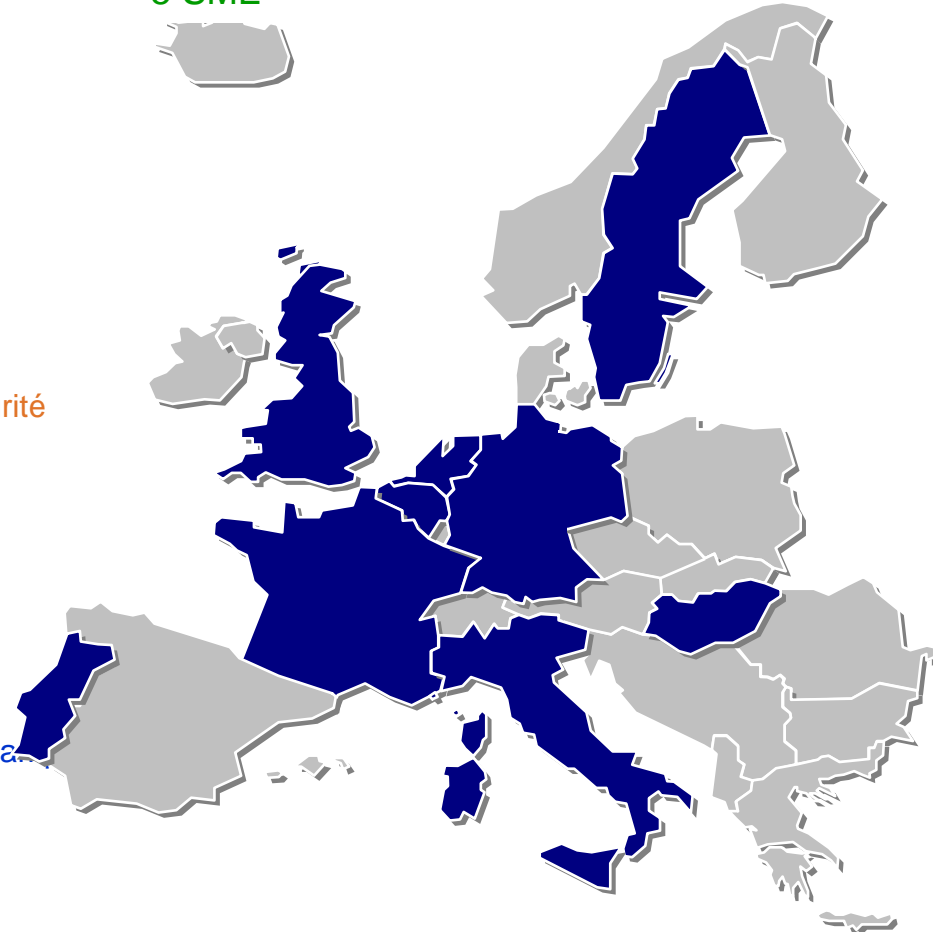
COSMA will help

- to improve the understanding of the effects of aircraft noise near airports
- to develop techniques for modelling the impact of aircraft community noise
- to develop engineering guidelines and operating practices aimed to minimise the noise annoyance, supported by a set of validated tools.

21 partners from 9 European countries.

- EADS Deutschland GmbH
- Snecma
- Leuven Measurement Systems International N.V.
- AIRBUS OPERATIONS SAS
- Alenia Aeronautica S.p.A.
- 01dB-Metravib
- SASS acoustic research & design GmbH
- Institut für Technische und Angewandte Physik GmbH
- ZEUS GmbH Centre for Applied Psychology, Social and Environmental Research
- Projecto, Empreendimentos, Desenvolvimento e Equipamentos Científicos e de Engenharia
- Deutsches Zentrum für Luft- und Raumfahrt e.V.
- National Aerospace Laboratory
- Institute National de Recherche sur les Transports et leur Sécurité
- Budapest University of Technology and Economics
- Forschungsgesellschaft für Arbeitsphysiologie und Arbeitsschutz
- Dipartimento di Ingegneria Mecc. e Ind. Università degli Studi Roma Tre
- Université de Cergy Pontoise
- Kungliga Tekniska Högskolan
- Università' di Napoli "Federico II" DPA
- Institute of Sound and Vibration Research - University of Southampton
- Safran Engineering Services

6 from industry
 7 universities
 3 research organisations
 5 SME



WP 1

Specifications,
Assessment and
Exploitation

WP 2

Annoyance
Examinations

WP3

Sound
Engineering

WP4

Virtual
Resident

WP5

Optimisation
of airport noise
scenarios

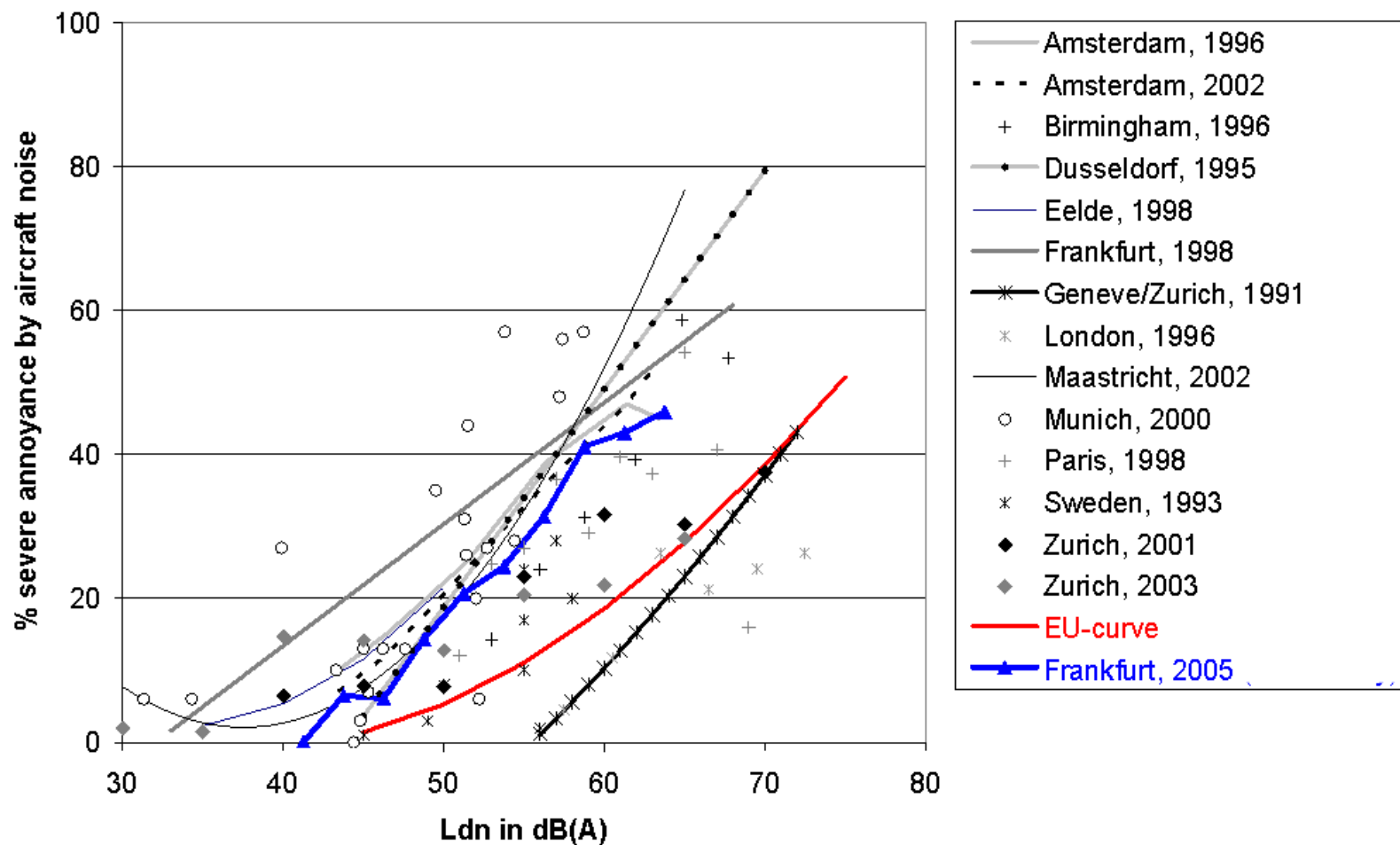
Project leader:



Project time: June 2009 – May 2012

Expert Panel:

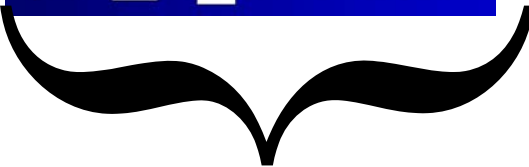




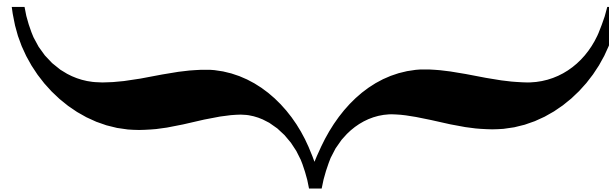
Source: van Kempen & van Kamp 2005, p. 25, Fig.3b, modified and supplemented

Source of Zurich 2001/03: Brink et al. 2006

„Aircraft Noise Annoyance“, surveyed by the ICBEN scale for assessment of noise annoyance

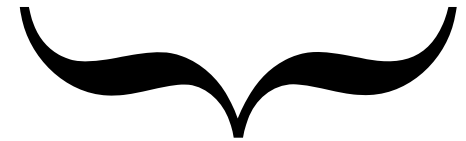


~ 1/3rd of total variance explained by L_{Aeq}



~ ?% of total variance explained by moderators as

e.g. attitudes and expectations towards current and future air traffic, procedural fairness, coping measures, social status, noise sensitivity, age, sex, house ownership etc. etc.



~ ?% of total variance might be random

Guski, R. (1999). Personal and social variables as co-determinants of noise annoyance. *Noise and Health*, 3, 45-56

- T2.0 Current state of knowledge: **literature review** and **original data** from Frankfurt Airport study FRA-S (**current** airport scenarios)
(involved partners: ISVR, NLR, ZEUS)

- T2.1 **Telephone** and **Field studies** (**current** airport scenarios, sound quality)
London Heathrow, Stockholm Arlanda, Cologne/Bonn Airport
(involved partners: DLR, IFADO, ISVR, KTH, statistical analysis: IFADO)

- T2.2 **Laboratory studies** (**future** airport scenarios, sound quality)
(involved partners: BME, INRETS, UCP, statistical analysis: IFADO)

- T2.3 Interactive laboratory **SOUND SYNTHESIS MACHINE** examinations
(**sound quality** of current and improvement of future aircraft sounds)
(involved partners: BME, DLR, INRETS, ISVR, UCP, statistical analysis: IFADO)

Content of the telephone interview, 1200 at each airport

Section	Subject	Containing questions about ...
0	Introduction	
1	Residential area	... duration of residency & satisfaction with living environment
2	Noise annoyance	... long-term aircraft noise annoyance & annoyance due to other noise sources
3	Attitudes	... general and specific attitudes towards local airport and air traffic, environmental consciousness, recent media coverage, suggestions for the airport
4	Coping measures	... measures to cope with noise
5	Personal information	...demographic data (age, sex, profession...), questions about, noise insulation
6	End of the interview	...further comments on aircraft noise

altogether more than 40 questions in telephone interview

**Airports: London-Heathrow, Stockholm Arlanda, Cologne/Bonn
(50 participants each)**

Main questions

- How does aircraft noise annoyance develop throughout the day?
- How does this short-term annoyance contribute to the overall annoyance?

What is new?

- Sound pressure level is measured continuously (and not only calculated)
- One-hour examination periods to assess event-based aircraft noise annoyance and for two hours sound quality for every overflight

Experimental protocol

preliminary inquiry	time		evening before first testing day	1 st day (ASTA)	2 nd day (ASTA)	break	3 rd day (ASTA)	4 th day (ASTA)	break	5 th day (ASO)	6 th day (ASO)
Inspection of housing, Information about daily routine, extreme personality traits etc.	mornings	7:00		MQ	MQ		MQ	MQ			
		8:00		ASTA	ASTA		ASTA	ASTA			
		9:00		ASTA	ASTA		ASTA	ASTA			
		10:00		ASTA	ASTA		ASTA	ASTA		ASO	
		11:00		ASTA	ASTA		ASTA	ASTA			
	noon/ afternoon	12:00		ASTA	ASTA		ASTA	ASTA			
		13:00		ASTA	ASTA		ASTA	ASTA			
		14:00		ASTA	ASTA		ASTA	ASTA			
		15:00		ASTA	ASTA		ASTA	ASTA			
	early evening	16:00		ASTA	ASTA		ASTA	ASTA			
		17:00		ASTA	ASTA		ASTA	ASTA			
		18:00		ASTA	ASTA		ASTA	ASTA			ASO
		19:00	OQ, installation	ASTA	ASTA		ASTA	ASTA			uninstalling
	late evening	20:00		ASTA	ASTA		ASTA	ASTA			
		21:00		ASTA	ASTA		ASTA	ASTA			
		22:00		ASTA	ASTA		ASTA	ASTA			
		23:00						CQ			
		24:00									

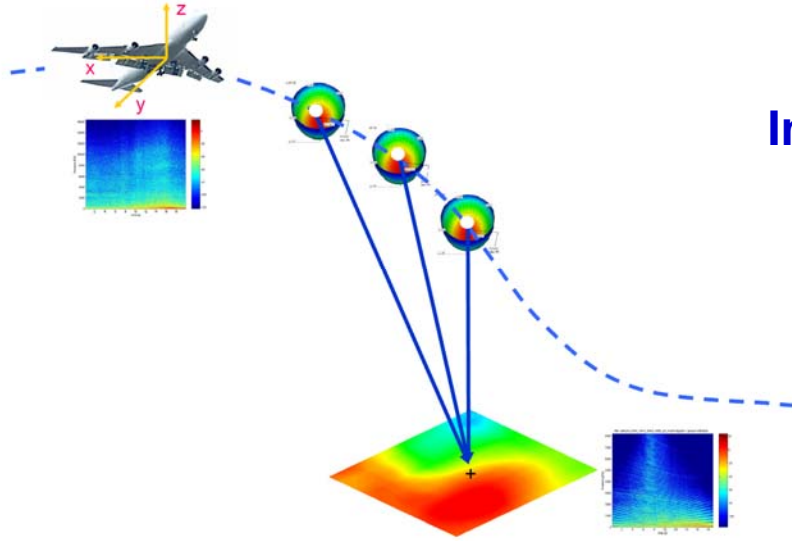
Key

OQ = Opening Questionnaire MQ = Morning Questionnaire ASO = Assessment of single overflights
 ASTA = Assessment of short-term annoyance CQ = Concluding Questionnaire

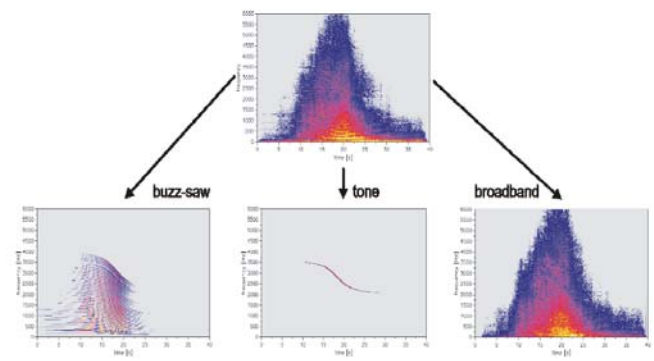
Observer has to be present

No observer has to be present

Improving Sound Quality of Aircraft Noise



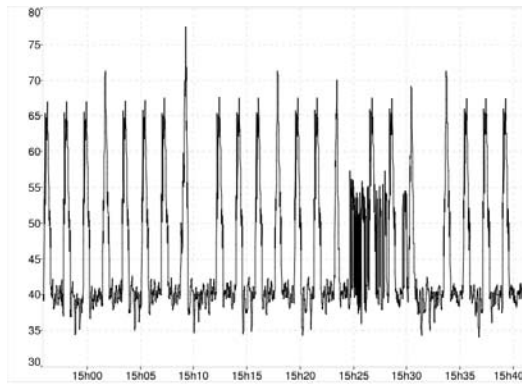
Input WP 3



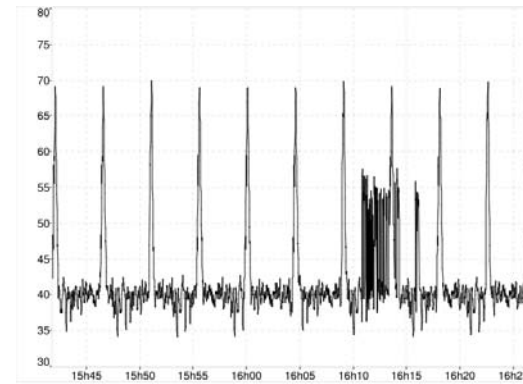
Faders representing different aircraft noise sources



Assessing future aircraft noise and airport noise scenarios



Seq1TO



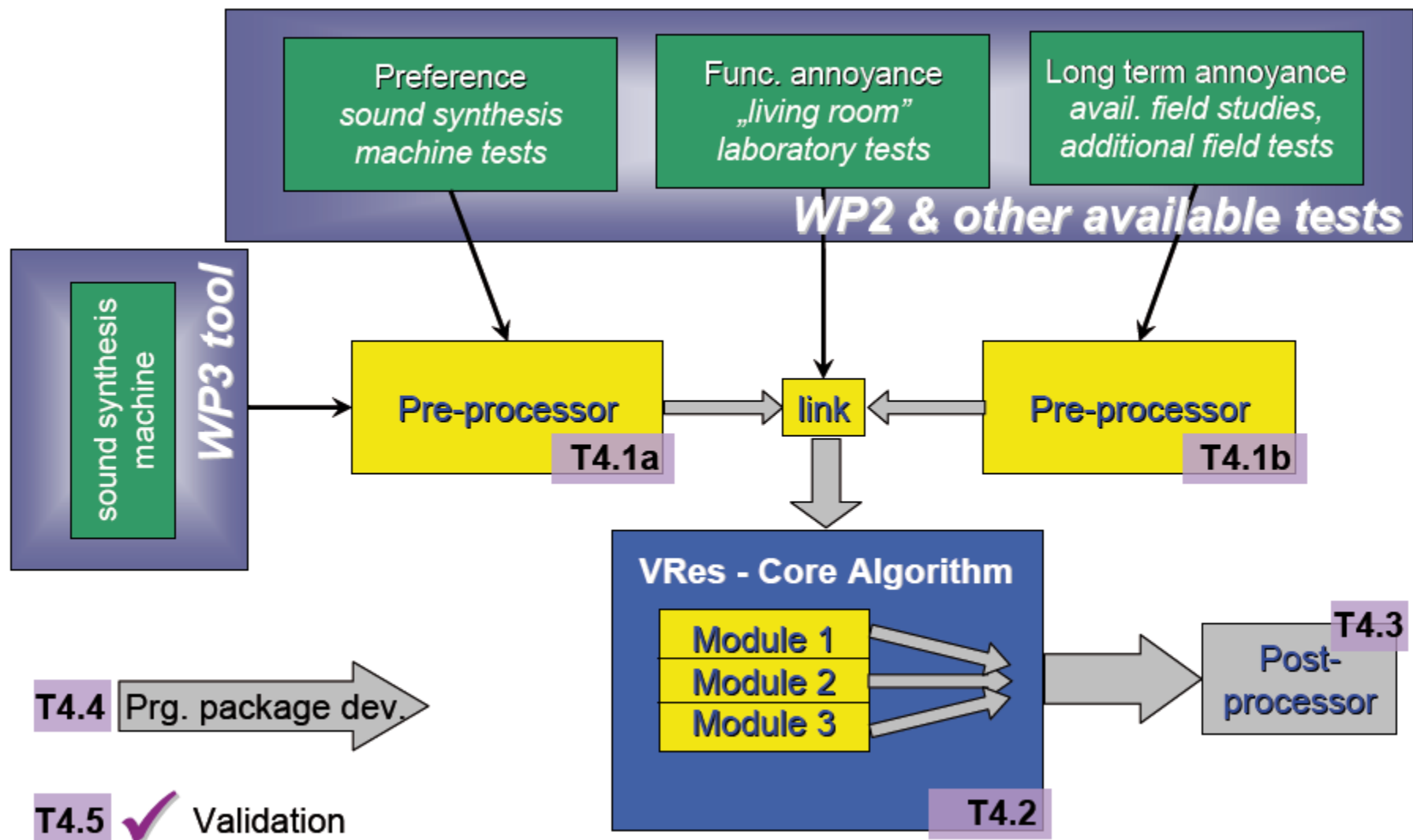
Seq4TO

Input WP 3

Input WP 5

Experimental protocol (duration: 185 min)

Phase	Activities and tasks	Noise exposure	Time duration
1. Welcome	<ul style="list-style-type: none"> Information and instructions about the experiments Questionnaire (Q1) Training Grammatical Reasoning Test or Stroop Test 	Back. Noise	30 mn
2. Experiment (1st run)	Reading magazines	Aircraft & Back. noise	30 mn
	Grammatical Reasoning Test or Stroop Test		15 mn
	Short term annoyance and activity disturbance questionnaire (Q2a)	Back. noise	5 mn
3. Break	<i>free time - change of scenario</i>	Back. noise	10 mn
4. Experiment (2nd run)	Reading magazines	Aircraft & Back. noise	30 mn
	Grammatical Reasoning Test or Stroop Test		15 mn
	Short term annoyance and activity disturbance questionnaire (Q2b)	Back. noise	5 mn
5. Break	<i>free time</i>	Back. noise	10 mn
6. Assessment single overflights	Instructions	Back. noise	3 mn
	<ul style="list-style-type: none"> Listening 5 aircraft passages Questionnaire (Q3a to Q3e) : after each passage 	Aircraft noise Back. noise	7 mn
7. Concluding questionnaire	Questionnaire 4 (moderators)	Back. noise	5 mn
8. Audiometry	Audiometric test	Quiet room	10 mn
9. Debriefing	Interview by the experimentator	Quiet room	10 mn



Public Website

Project Consortium Workpackages

COSMA — 7th framework EU project

COSMA (Community Oriented Solutions to Minimise Aircraft Noise Annoyance) aims to develop engineering criteria for aircraft design and operations in order to reduce the annoyance within airport communities due to aircraft exterior noise. By today, such criteria do not exist, since aircraft noise engineering has historically focused on achieving ever lower noise levels for individual events and at close distance from the runway.

Within the frame of a unique approach, COSMA will improve the understanding of noise annoyance effects due to aircraft in the airport surrounding community. The results from field studies and psychometric testing will be used for setting up optimised aircraft noise shapes. Special techniques for a realistic synthesis of aircraft noise around airports will be developed for the simulation and validation of optimised aircraft noise shapes. Associated engineering guidelines for the necessary optimisation processes will be established, which needs a profound knowledge management for aircraft design practices and scientific information on aircraft exterior noise annoyance effects. The scientific research results will help to reduce noise annoyance at the source in the future, by technological or operational means and through an improved understanding of the related effects of aircraft noise in the airport surrounding community.

Description of Work

Exploitation of earlier EU projects

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Expected Results

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SEVENTH FRAMEWORK PROGRAMME

Cosma is funded under FP7 by the European Commission.

Project reference: 234118

Start date: 01/06/2009

End date: 31/05/2012

Research Area: AEA T.1.1.3 Green Air Transport Operations, AAT-2008.1.3.2 Airports

copyright contact sleep

Project Consortium Workpackages

Consortium of the project

Airbus - Airbus France SAS

AIRBUS OPERATIONS SAS, one of the four wholly-owned subsidiaries of AIRBUS SAS (an EADS company) is a limited liability company (société par actions simplifiée) fully organized and existing under the laws of France, having its registered office at 110 route de Beynes, 33540 Toulouse, France, registered under number: RCS Toulouse 303 341 532 and represented by its General Manager (M. Jean-Frédéric Thomas, AIRBUS OPERATIONS design and manufacture aircraft, aircraft parts, systems, equipment and derivative products, and also provides services in the field of aeronautics. About 17 600 employees are working in AIRBUS OPERATIONS and 57 300 for all AIRBUS. Regarding research activities the self-funding R&D amounts in 2003 to round Euros 0.8 billion. AIRBUS OPERATIONS Engineering is separated in one major design office in Toulouse.

Role in COSMA

AIRBUS will contribute to:

- WP1 for the selection of Powerplant and Airbus aircraft representatives of a current fleet in a typical airport.
- WP2 for the definition of the under flight path noise control points.
- WP3 for the prediction of total noise spectra on ground for the reference and optimized trajectories.
- WP4 for the definition of current and future scenarios to be tested in laboratory.

URL

<http://www.airbus.com/>

INRETS - The French National Institute for Transport and Safety Research Transport & Environment Laboratory

INRETS is a public research institute with more than 400 permanent staff located mainly in Paris, Lille and Lyon (head Office). Since 1970, INRETS has considerable experience of research activities in the field of environment particularly at LTE (Transport & Environment Laboratory). INRETS/LTE (<http://www.inrets.fr/ter/ter/>) has been involved in the field of transportation noise for many years. LTE addresses not only noise emission (measurement, modeling, etc.) from different means of transport (cars, trucks, trains, airplanes) but also perception and annoyance issues (psycho-acoustic surveys (field study) as well as experiments in laboratory (lab study)).

Role in COSMA

INRETS will contribute to the COSMA project (WP2) by addressing:

- perception of preferred aircraft sounds by participating in aircraft sound synthesizer listening tests in laboratory (task 2.3);
- noise annoyance by participating in laboratory studies and in a combined field and laboratory study in order to address the transferability of the laboratory results to real life conditions (task 2.2). Methods and tests specified and coordinated by INRETS will be harmonized with those of field studies (task 2.1.1).

URL

<http://www.inrets.fr/>

PEDECE -

Role in COSMA

URL

<http://>

ISVR - Institute of Sound and Vibration Research, University of Southampton

SASS - SASS acoustic research & design

SASS has a long term experience in industrial target sound

Project Consortium Workpackages

COSMA — WP4 Virtual Resident

WP0 Project coordination

WP1 Specifications, assessment and exploitation

WP2 Annoyance evaluation

WP3 Sound engineering

WP4 Virtual resident

WP5 Optimisation of airport noise scenarios

What is going on

Long term annoyance

Expected results by November 2010

An extensive field test has been performed by Zeus Orbi in 2005 around Frankfurt Airport to capture subjects' annoyance caused by aircraft noise. Further analysis by 10% of the data is performed currently in order to develop a neural network model for predict most user's annoyance. A multi-level approach, making use of various statistical methods, is applied to diversify the huge input space into an optimal representation of the relevant data. This is the key challenge of the task. The optimized dataset is then used to teach the neural network.

Sound quality

Expected results by November 2010

3 partners are focusing on the application/development of advanced non-linear time-frequency domain (psycho-acoustic) descriptors. The optimized special parameters are tested on a former aircraft-noise sound quality test data.

Results achieved so far

The long-term predictor has been set up.

2010 May

First version of the long-term predictor based on the Frankfurt Study has been set up. Results show a mean prediction error below 10%, based on a parts of the correlation, recommendations for WP2 field studies has been formulated.

Best candidates as advanced aircraft sound quality descriptors have been identified.

2010 May

Objectives

The main goal of WP4 is to develop a virtual resident (VRes) tool simulating human subjective perception of aircraft noise. As part of the model, the VRes tool will be able to predict human response to single aircraft sounds (e.g. sound quality), as well as the long-term annoyance of airport residents who are regularly exposed to multiple events. Deeper understanding of sound quality preference is expected to cover up a part of unexplained variance in long-term annoyance in current level based analysis. Accurate and psycho-acoustic features of aircraft sounds (e.g. loudness, tonality, buzz-saw, etc.), multiple event descriptors (e.g. number of events, time duration between events, peak and overall loudness, etc.) and non-acoustic moderators (e.g. social status, mood, etc.) will all be taken into account to create the virtual resident's response in terms of annoyance or preference.

The structure of the VRes tool will be illustrated through the following figures:

The intelligence, i.e. the knowledge base of the VRes tool will come from different sources:

- Laboratory listening tests performed in the frame of project 2009.
- Literature reviews and results of recent field studies (e.g. Frankfurt 2005 Study).
- Laboratory tests, field studies and combined laboratory/field tests performed in WP2.

Sound feature related threshold tests performed with the WP5 On-line Sound Synthesis Platform.

The VRes tool will be developed into a standalone executable program and will be extensively tested and validated. The tool will further be used as a close interface with the WP3 Airport Noise Climate Synthesizer tool to predict the annoyance of various airport scenarios (e.g. current scenarios, optimized future ones, etc.) specified by WP5.

www.fp7-cosma.eu

Cooperation EU - U.S.A:



Possible Call: July 2012



Any ideas? Please contact:

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WP2 leader COSMA

Thank you for your attention!

