Annex 1g
Technology Evaluator

CLEAN SKY

2009 Annual Implementation Plan

Annex 1g

Technology Evaluator

Description of work for Year 2009

May 12th, 2009

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RECORD OF REVISIONS

Revisions	Date	Description
Issue 1	Jan. 23rd, 2009	Initial version, compiled by Thales (O. Hiernaux)
Issue 2	Jan. 26th, 2009	Updated version (inputs from Airbus, Cranfield, NLR)
Issue 3	April 29th, 2009	Updated version (inputs from CIRA in WP4)
Issue 4	May 12th, 2009	Correction of typos on pp. 4 & 7

TE Description of Work for year 2009

Clean Sky's TE initial start of activities was set to September 1st, 2008.

2009 activities shall be conducted on a 12-months period, from January 1st, 2009, to December 31st, 2009.

All TE Work packages shall be active in 2009:

- TE0: TE Management and Coordination
- TE1: TE Requirements and Architecture
- TE2: Models Development and Validation
- TE3: Simulation Framework Development + IVV
- TE4: Assessment of impacts and Trade-off studies

The following paragraphs provide an overview of the works that shall be performed in these Work Packages during the Year 2009.

1 TE0: TE Management and coordination

1.1 TE0 Overview

Thales and DLR shall be the 2 Leaders of the TE.

The TE shall be governed according to the following structure:

- A Steering Committee, *headed by the JU Director*, with all TE Members (ITD Leaders and Associates), will be in charge of Strategic decisions and supervision regarding the TE (but the SC is external to the TE)
- The Coordinator, i.e. Thales, will be in charge of performing the administrative coordination of the TE
- A Consortium Management Committee (CMC), lead by Thales, will be in charge of preparing the SC meetings
- A Program Management Committee (PMC), lead by DLR, will be in charge of the day to day and overall technical / scientific coordination of the Project

1.2 TE0 Work Programme for 2009

1.2.1 TE0.1: Administration and Coordination

These overall TE management tasks are performed by the TE leaders (Thales and DLR), with Thales mainly doing Administrative coordination of the TE, and DLR mainly doing Technical and Scientific coordination of the TE.

1.2.2 TE0.2: TE internal reporting

This task will be consisting of the coordination activity with TE WP leaders at level 1 and the preparation of reports to the JU. This will be done through the TE Leaders, within the frame of the Programme Management Committee (PMC).

1.2.3 TE0.3: Consortium Management Committee

This task will be consisting in preparation of the recommendations to the TE Steering Committee., as the CMC will assist and advise the TE Steering Committee in its function. The CMC is composed of all the TE Members.

In 2009 the main tasks to be performed will be reviewing the 2009 detailed TE programme of activities, the detailed total (over 7 years) TE programme of activities, validating the TE management plan, the preparation of PMC, CMC meetings and SC meetings, the TE 2009 annual reporting package as well as a 6 month progress review.

2 TE1: TE Requirements and Architecture

2.1 TE1 Overview

The general objective of this WP is further definition of Requirements and Architecture of the Clean Sky Technology Evaluator.

Based on findings and agreements reached in the preparation phase – as reflected in the TE WBS – this task will further detail work requirements and respective architecture of the model framework and the overall work.

2.2 TE1 Work Programme for 2009

2.2.1 TE1.1: Definition of TE inputs

The input definition is a prerequisite and first step of the technology evaluation, however it has to be based on the methodology applied and the expected outcome. Thus, the input definition will be done in parallel and in close cooperation with task TE1.5 “Definition of the TE operations and architecture” and task TE1.2 “Definition of TE metrics and outputs”.

In this context, technology relevant for evaluation is understood in a comprehensive manner, i.e. technology comprises every possible means for air transport improvement (hardware/software, processes, methodologies, etc.). Consequently the number of relevant parameters for all technologies is large. A general format has to be specified which enables the partners within the ITD to provide the necessary input to the TE.

The first step is a review and listing of all relevant prospective ITD results. Together with the ITD partners the defining technology parameters are derived. Furthermore the technology system environment and the reference have to be specified together. Of equal importance as the stand-alone evaluation of single technologies is the combined evaluation of multiple technologies within a system. Therefore, in a second step, the grouping of relevant prospective ITD results for cross impact studies will be done with the ITD partners. Subsequently, the derived list will be mapped

with the methodology and architecture requirements of task TE1.2 and TE1.5. In an iterative process a coherent input format will be set up.

In 2009, the work will start on the following tasks:

- Listing of relevant prospective ITD results for technological evaluation and
- Grouping of relevant prospective ITD results for cross impact studies

2.2.2 TE1.2: Definition of TE metrics and outputs

With the work description of TE4, the overall metrics to be applied in the assessment process (e.g. delta fuel burn, delta noise…) are in most cases already set. However, the detailed boundary conditions, e.g. specific mission or aircraft type, are not yet specified. For the tasks 4.3.4, 4.4.7 and 4.5.13, starting beyond 2009, concerning the assessment of the success with respect to the ACARE goals, an additional problem arises from the open formulation and partly conflicting aim of the goals.

The first step is a review and listing of the intended metrics in TE4. Additionally a study will be carried out in order to identify further metrics to be possibly applied in this context. In a second step together with the ITD partners the boundary conditions will be exactly specified. This includes a clarification of the ACARE goals. Here, the findings of the ACARE Progress Evaluation Team and the outcome of the AGAPE (CSA, 1. call FP7) project will be used. This leads to a listing of all possible/intended metrics specified for each TE4 task individually together with the TE partners. Subsequently, this metric list will be mapped with the methodology and architecture requirements of task TE1.5 and the input form of task TE1.1 and adapted if necessary. For maximising the chance of inter-comparison the boundary conditions linked to the metrics should be universal. That means, wherever possible the assessment should be done for the same aircraft type, mission, routing etc. This will be respected in the definition of the boundary conditions. Finally, the outputs will be specified in detail together with TE partners.

In 2009 the work will start on the following tasks:

- Review and listing of possible/intended metrics and output and
- Review of boundary conditions

2.2.3 TE1.3: Methodology and Specifications for trade-off studies

Within TE1.3, the requirements for the trade-off studies will be performed.

The activity of this task will be related to the ITDs requirements.

A first subtask will be done to define the needs of the ITDs in terms of trade-off studies.

The activity will be followed by the definition of the methodology of trade-off studies, with respect to ITDs expectations and planning.

The third part of the task will be related to the specification of the models (as defined in TE2), tools (as defined in TE3) and data used in the TE 4.

Main objectives of work in 2009:

- To identify ITDs requirements in terms of trade-off studies

- To propose a methodology for the trade-off studies, with respect to the ITDs planning

2.2.4 TE1.4: Models and data consistency study, including with external projects

Within WP1.4, existing models and data will be gathered and evaluated with respect to re-usability and implied simulation framework requirements.

External related projects (like Sourdine II, OPTIMAL, and ERAT), and several Networks of Excellence will be consulted to investigate the experiences with the used models, data, and assessment procedures. In particular, deficiencies and/or problems due to inconsistencies with respect to used models/data will be evaluated.

Exchanges with SESAR shall also be initiated.

Main objectives of work in 2009:

- In 2009, focus will be on the models and data required for the first assessment cycle to be performed in 2010.

2.2.5 TE1.5: Definition of TE Operations & Architecture

The first step is a review and listing of the models respectively TE-modules available within the TE. The main task will be to collect/specify the needed input and intended output of all modules from all TE-partners.

Together with the input from Task TE1.1 “Definition of Technology Evaluator Inputs” and Task TE1.2 ”Definition of Technology Evaluator Metrics and Outputs”, this allows for a definition of the data flow, i.e. a sequencing of the TE-modules for a standard TE-application. The proposed limitation on measuring the performance of new technologies with respect to the ACARE goals simplifies the set-up in this context.

However, technology evaluation often requires individual/adapted treatment dependent on the technology in question. Thus, based on the Task 1.1-collection of input from ITDs (technology deltas, system information/context) for each relevant technology to be evaluated the standard TE-procedure will be adapted where needed.

The documented procedures will continuously be passed on to TE3 for preparing detailed specification of the Simulation Framework, and to TE4, for implementation and execution of assessments.

In 2009 the work will start on the following tasks:

- Specification of standard operation, i.e. procedure to be followed for technology evaluation
- TE Requirements and Use cases
- Specification of architecture, i.e.
  - Definition of input/output of each TE-module and data flow between modules,
  - Definition of Simulation Framework structure

3 TE2: Models development and validation

3.1 TE2 Overview

Models (software, databases, and scenarios) will be developed and validated in TE2.

Starting point for the development will be the requirements, use cases and TE architecture, as specified in TE1.

In TE3.3, the models will be integrated into the Simulation Framework for combining the three assessment levels: Mission, Operation, and ATS.

Model development is broken down in line with the three assessment levels:

The Mission level concerns single aircraft operations. A comprehensive set of models is required to be able to assess the technologies at mission level: mission models, air vehicle black box models and associated flight path models, platforms or components noise models (if needed for trade-off studies), atmospheric model, airport area models (3D geometry), noise propagation or carpet noise models for a single flight, mission fuel burn models, mission energy management models, mission emissions models, and finally simplified life cycle models.

Conceptual and reference aircraft and rotorcraft models will be delivered by SFWA, GRA, and GRC ITDs, as black boxes. Additional models will be developed in the TE, where necessary.

The Operational level concerns the air traffic movements at and around airports, including local surrounding airspace like Control Zones, Terminal Manoeuvring Areas, and Control Areas.

To explore the impact of Clean Sky technology, simulation models are required, as well as performance assessments models. Simulation models include airport models (generic and specific), including aircraft models and scenarios with traffic and procedures, and databases of the surrounding population.

Performance models include ATM impact (capacity) models, a local noise model, a mission fuel burn model, and a local emissions & air quality model.

The ATS level concerns air traffic operations at Regional/Global level. Required models include a Y2000 Flights/movements and Fleet reference build-up, a Y2020+ Traffic demand, Fleet, Routing, and Missions forecast model, a Y2020+ simplified life cycle model, and a Y2020+ Emissions Inventory model.

Since two assessment complete cycles are proposed, model development will be broken down into two phases, so that for the first cycle an initial set of models will be available, and the final models will be available, for the second cycle.

3.2 TE2 Work Programme for 2009

3.2.1 TE2.1 Models at Mission level

In this task, the requirements for models development and validation are defined, based on the outcome of the overall Technology Evaluator requirements and architecture from TE1.

The results from this work package are assessed for the scope of aircraft mission level, leading to requirements for this context.

The requirements pertain to all general aspects of model development and validation and define the (integration) context of all individual models to be developed at the mission level.

Model development requirements cover all phases of model: specification, mission, implementation, testing and verification

The activities within work package 2.1 are split into the following sub tasks:

- TE2.1.1 – Mission model
- TE2.1.2 – Air vehicle and flight path model
- TE2.1.3 – Platform or components noise model
- TE2.1.4 – Atmospheric model
- TE2.1.5 – Airport area model
- TE2.1.6 – Noise propagation / Carpet noise model
- TE2.1.7 – Mission fuel burn model
- TE2.1.8 – Mission energy management model
- TE2.1.9 – Mission emissions model
- TE2.1.10 – Simple lifecycle model

Main objectives of work in 2009:

- Select the best candidates for the models at mission level, in TE2.1
- Develop additional required models
- Interact with the ITDs for the use of Black Box models

3.2.2 TE2.2 Models at Operational level

The objective of this task is the development and validation of the models required to perform the assessment of JTI technologies at operational level.

Besides the development and validation of a local noise model, a fuel burn model, local emissions & air quality model and an ATM impact model also airport models (including scenarios with traffic and procedures) and databases of the surrounding populations are required and, where necessary, further developed and validated.

The operational level concerns the air traffic movements at and around airports, including local airspace like Control Zones, Terminal Manoeuvring Areas, and Control Areas.

To explore the impact of Clean Sky technology, simulation models are required as well as performance assessments models.

Simulation models include airport and aircraft models, as well as population databases. Assessment models include ATM impact, local noise, fuel burn, and local emissions models.

Models development and validation at operational level will be based on the requirements generated in WP1.

The requirements pertain to all general aspects of model development and validation and define the (integration) context of all individual models to be developed at the operational level.

Aircraft simulation models will be derived from the models developed in WP2.1, at mission level.

Main objectives of work in 2009:

- Preparation of existing models, and design and development of additional models, as required in the first assessment cycle, including an initial baseline assessment.
- Design of additional models required in the second assessment cycle.

3.2.3 TE2.3 Models at ATS level

The objective of this task is to elaborate/provide the models and data to perform the assessment of Clean Sky technology at Air Transport System (ATS) level in TE4.5, including the Y2000 Flights/movements and Fleet reference build-up and the improvement/adjustment/development of models (e.g. Airbus GMF), as well as their validation.

Besides the traffic demand and fleet forecast models (Airbus, Alenia and Dassault for aircraft and AgustaWestland, Eurocopter for rotorcraft), a simplified life cycle model is required. In addition data inputs for the use of the emission inventory will require several adjustments and data on airport constraints as input for the routing and mission forecast model will be collected and adjusted to fit model requirements. Improvements for Climate Impact model would be required to assess impacts from contrails and cirrus clouds if the JTI partners decide to perform a climate impact assessment.

In 2009, the following tasks will be started:

- Y2000 Flights/movements and Fleet reference build-up
- Y2020+ Traffic demand, Fleet, Routing & Missions forecast models
- Y2020+ Simplified life cycle model
- Y2020+ Emissions Inventory model

4 TE3: TE Simulation Framework development + IVV

4.1 TE3 Overview

The objectives of this work package are threefold:

- Define and develop all tools needed for the assessment of the technologies, as developed in the Clean Sky ITDs, meaning network and facilities management and also simulations monitoring,

- Define and develop the methodology and tools for the integration of the physical models developed in TE2, following requirements and specifications of TE1,

- Define and develop the tools and interfaces needed for the three levels of assessment, depending on assessment scenarios and expected results as specified in TE1

The activity of TE3 is structured into 4 work packages at level 2:

- TE3.1: TE input data base structure definition
- TE3.2: Development of simulation framework
- TE3.3: Integration, Verification, Validation
- TE3.4: Simulation Configuration Control

Le last Work Package (TE3.4) shall not be started in 2009.

4.2 TE3 Work Programme for 2009

4.2.1 TE3.1: TE input data base structure definition

The input data base structure is part of the simulation framework developed in TE3.

This database will provide all input parameters for the evaluation of the new aircraft technologies.

For the evaluation of aircraft technologies several multi-disciplinary simulations of both single flight (aircraft mission level) and multiple flights (aircraft operational and global ATS level) will be run.

This leads to a very high amount of input data. For an efficient and simple data handling, a reasonable data base structure is essential.

For the development of the input data base structure, the following two tasks have to be carried out:

- Collection of input parameters
- Building the data base structure

Main objectives of work in 2009:

At the beginning, all input parameters of all relevant models integrated into the framework need to be collected.

Thereby, the TE inputs defined in Task 1.1 and the models developed in WP 2 have to be considered.

4.2.2 TE3.2 Development of Simulation Framework

The objective of this task is the development of the simulation framework. The level of integration of this simulation framework will be defined in TE1.5.

This task will address the methodologies and the tools for simulation framework architecture, case studies selection, data bases management, scenario definition and preparation of results.

The architecture of the simulation framework will be designed and developed for the three levels of evaluation (mission, operational and ATS levels), with the main objective of the integration of the models, as developed in the TE2.

In accordance with outcome of TE1.5, an overall integrated network should be defined, in order to reach the right level of communication and consistency between mission, operational and ATS levels of evaluation.

Main objectives of work in 2009:

The 2009 objectives of this task will be based on the WP 1.5 outputs and will address the start of the following activities:

- Case studies selection in close relation with ITDs requirements and outputs for the TE
- Simulation architecture definition in order to define for each case studies which models will be used and exchanged data between models
- Data management concerning input data and results
- Simulation scenario definition and results preparation

4.2.3 TE3.3 Integration, Verification, Validation

The objective of this task is to integrate the framework software, as developed in Work package 3.2, with software models as developed in Work package 2, in line with the use case development plan from TE1.

Verification and validation of the integrated framework will be performed with respect to the interactions between the simulation levels of TE platform (design level, operational level, ATS level), also indicated as the 4th level - the overall integrated network, as well as with respect to the interactions between the simulation framework components at a fixed level (design level, operational level or ATS level) and the models, as connected to the framework.

Verification and validation check the integration result on its conformance with respectively the TE platform specification (correctness of development) and the expected simulation capabilities (fulfilment of JTI assessment requirements and goals).

Model validation is not part of the validation task. This work is part of the model development work package 2.

The stand-alone model provides a reference for the model capabilities and produced results.

Also the integration of the simulation components (systems, software components, tools) within one simulation level, is not part of the work. This work is part of TE simulation framework development (TE3.2).

Calibration and acceptance of the platform for assessments are parts of Work Package 4

Main objectives of work in 2009:

- In 2009, the use case development plans for the first assessment cycle will be detailed into an integration, validation and verification plan.

5 TE4: ASSESSMENT OF IMPACTS AND TRADE-OFF STUDIES

A single task of this WP will be started in 2009: TE4.1: TE input data preparation support, in conjunction with works in TE1, TE2 and TE3.

5.1 TE4 Work Programme for 2009

5.1.1 TE 4.1 TE Data Input Preparation Support

The TE4.1 is focused on the definition of procedures and tools to convert design parameters belonging to ITDs into parametric data sets. The final aims is tuning the model parameters in order to guarantee that the parameterised model is able to match as much as possible the behaviour of the complete one defined at ITD level. The understanding is that ITDs provide some black box models (aircraft, rotorcraft, etc.), plus parameters and data related to the developed technologies, whereas parametric models needed for technology performance evaluation will be developed in the TE (WP2). Thus a tuning of the parameters is needed before performing the assessment of JTI technologies.

The proposed procedure will keep under control in a systematic way the level of confidence of the developed parametric models.

Main objectives of work in 2009:

- In 2009, activities in this WP shall be limited to firstly define the right procedures to be applied in order to derive TE parametric models data according with the final aims of the WP above described. Then the preliminary functional requirements of the numerical tools needed in order to implement the selected procedures will be identified. These activities will be performed in parallel for Large Aircraft (Task TE4.1.2), Green Regional Aircraft (Task TE4.1.3), Green Rotorcraft (Task TE4.1.4), by guaranteeing in any case adequate harmonization of procedures and tools (Task TE4.1.1).