"**S**tudy of **O**ptimisation proced**UR**es for **D**ecreasing the **I**mpact of **N**ois**E** **II**"

Executive Version Part B

Date of Preparation:	29 September 2000
Specific Programme:	Promoting Competitive and Sustainable Growth
Key Action:	Sustainable Mobility and Intermodality
Type of Project:	Research & Development (RTD)

Task 2.2.3/11 Impact assessment of procedures and technologies to increase air transport system capacity and safety, and reduce environmental impact

B2. Table of Contents

B3. Confidential proposal summary

B3.1 Societal needs and community added value

With the continuing growth of air traffic as well as the ever increasing level of urbanisation around most airports in Western Europe, the impact of aircraft noise and emissions on the quality of life for the surrounding communities has become a serious issue to be dealt with. Many European airports already face the conflicting problems of increasing their airport capacity to meet the amount of traffic, and the increasing pressure from the general public to reduce environmental impact, particularly noise and emissions, of the increased traffic volume. This has already resulted in specific local constraints to the operation of aircraft, not only around major airports such as Schiphol, Gatwick or Frankfurt, but also more regional airports are already experiencing the pressure to impose constraints to aircraft movements. Therefore, reduced nuisance to the community is a serious issue for the airline transport industry if the projected sustained growth is to be pursued.

Many efforts are already being undertaken to reduce the source noise itself by the introduction of more silent aircraft and engines. Several projects funded by the EC investigate the technology required to achieve this objective for the European aviation industry. Results of these programmes such as RANNTAC, RESOUND, RAIN and DUCAT are made public through the X-Noise thematic network.

On the other hand, a further solution to noise reduction around an airport is the definition of **new approach and departures procedures**. By modifying or optimising the operations and traffic flow of aircraft around the airport, it should be possible to achieve noise reduction.

All involved parties agree that there is a clear need for an integrated approach at a European level since, in view of the projected growth of traffic, it will be necessary to provide increased airport capacity while maintaining a high level of safety and complying with ever-stricter environmental constraints. This will then result in an acceptable growth, which the community may benefit from.

B3.2 Program technical and scientific objectives

SOURDINE II is a Research, Technology development and Demonstration (RTD) project aimed at providing solutions to the following issues:

- Airport approach and departure procedures that are aimed at reducing the environmental (noise and emissions) impact around airports require a co-ordinated solution by all involved parties. A European and international standardisation and harmonisation of such procedures is required in order for them to become operationally acceptable and only then can such new procedures be easily introduced on a larger scale and at a level of safety acceptable to the community.
- Provide an accepted implementation plan by all involved stakeholders to be able to migrate from the current situation to advanced environmentally friendly approach and departure procedures. This avoids the need to develop specific local solutions to a European problem.
- Produce air traffic controller and pilot tools to guarantee a high level of safety for the new advanced procedures
- Produce tools for policy makers to provide insight into the relation between safety, the environment, efficiency and financial aspects.

This work will contribute to the work programme for Competitive and Sustainable Growth of the European Community, the Key Action for Sustainable Mobility and Intermodality. More specifically, SOURDINE II will address task 2.2.3/11, “Impact assessment of procedures and technologies to increase air transport”, which is included in the 3rd call for proposals of 6 June 2000 under the GROWTH Programme, Fixed Deadline Call for RTD, Demonstration and Combined Projects, Call identifier: GROWTH June 2000.

The duration of the project is three years and is expected to start in the short term, i.e. in the first half of 2001. Work carried out under this project will be tightly linked with other projects, in particular a number of activities within the SILENCER project. When possible, thematic networks such as X-Noise will be used for additional dissemination.

Principle innovative elements are the development of a thoroughly validated and harmonised implementation plan for new advanced noise abatement solutions. New procedures are identified through brainstorms supported by representatives from all involved parties. The results from the previous 4th FW SOURDINE project will be used as an initial input.

The validation will be performed according to a thorough validation methodology, using fast-time and real-time simulations to evaluate environmental, capacity, safety and financial effects of the new procedures.

Moreover, the project will also include the development and validation of advanced controller and pilot tools, which are needed to achieve more environmentally friendly airport operations, without impeding the growth in air traffic and maintaining or increasing the present level of safety.

B3.3 Partnership

Since the work to be carried out requires the involvement of the entire air traffic industry, representatives from all concerned parties will be involved during the project:

- The **consortium** for SOURDINE II consists of **FOUR** research institutes to provide technological input and simulation support, **ONE** aircraft manufacturer and **TWO** ATS-service providers. Furthermore, **TWO** engineering companies provide technological and financial expertise. Five countries are involved in the project.
- The **expert panel** for SOURDINE II consists of representatives of the *regulatory organisations, airlines, industry (aircraft, engines and ATM systems), ATS providers and airports.* The expert panel will be set up to support brainstorm sessions and reviews of results. Intentions to participate in the expert panel have already been received from a large part of the aimed panel.

B3.4 Management

The project will be managed by a team which has a long experience with large RTD projects. The management structure comprises a project co-ordinator, a technical manager and work package leaders. The project **co-ordinator** will be responsible for overall project co-ordination and will be the main interface between the consortium and the European Commission. The **technical manager** controls the execution of the project, in terms of technical matters.

In addition, an **exploitation manager** will be assigned who will work closely with the project co-ordinator for the exploitation and a broad dissemination of project results.

B3.5 Economic development perspectives and technology progress

Given the forecast increase in air traffic in the next 20 years and the current/expected imposed environmental constraints, it is evident that the current generation ATM systems, procedures and airborne equipment will be subject to major enhancements in order to handle this increase in air traffic. If no structural solutions are found for the capacity problem, the airline industry growth will be limited. The SOURDINE II project will address the capacity problems on the long term. It will guide research, development and implementation in the optimal direction for capacity increases within the imposed environmental constraints. This will enable airlines and all affected industry, from aircraft manufacturers to travel booking offices, to economically grow and increase employment on a broad scale in the European member states. The deliverables of SOURDINE II will help to increase the technological knowledge regarding the development and validation of environmental friendly procedures and supporting air traffic controller and pilot tools.

B4. Scientific and technical objectives and innovation

B4.1 International state of the art

In addition to the increasing traffic demand, new constraints on the flow of traffic have been imposed and limit the capacity and efficiency of air transportation. This influences the European economy on the broader scale. Apart from airport and airspace capacity issues that need to be resolved to accommodate further growth, the air transport industry is also facing increasing constraints with respect to environmental pollution. More and more airports within Europe, as well as world-wide, are faced with noise and emission restrictions imposed by government or local authorities.

International developments in this area to obtain internationally accepted standards and new operating procedures are however progressing at a slower rate than desired in view of the increased community awareness of environmental pollution. This has already resulted in the imposition of local restrictions and regulations at many European airports, which in view of the dense population are relatively more affected compared with other parts of the world.

Compliance to these many different rules and specific local restrictions is a particular burden and issue for the European airline industry, which is why, in particular within Europe, there is a strong need to come to a unified approach in dealing with the reduction of noise and emission. This harmonised approach should deal with the following issues:

- Determination of the environmental impact, noise and emission, around an airport through the application of the same measurement methods and regulations throughout the EU, instead of different regulations by individual members states or airports.
- Environmentally friendly operating procedures for the airlines that can be applied at any airport without the need for the many specific local constraints that are in place today.

Up to now, however, within Europe, there have been only limited initiatives to provide a implementation plan for the strategic implementation of a harmonised European environmentally friendly policy as well as the definition of standardised operating procedures. Often actual implementation was hindered by the differences between countries and the lack of technology to realise the desired objectives, although economic viability has been clear from the outset.

The (4FW) Sourdine project has already identified a number of promising procedures and methods that could be applied to achieve this harmonised approach within the EU. The Sourdine II project is proposing to go a step further, by developing enabling technologies, tools and methods to ensure the safe, efficient and economic operation of new noise abatement procedures.

In order to succeed at a European scale, it is necessary to include all involved parties into the development process. The SOURDINE II project will therefore set-up an expert panel in addition to the consortium to avoids possible rejection of the final results of partners not involved (the 'not invented here' syndrome).

B4.2 Scientific and technical research objectives and technical achievements

The conclusions of the initial Sourdine project have already clearly indicated that the introduction of new noise friendly operating procedures can only be successful provided the current airport capacity and safety levels are not negatively affected. Current noise abatement measures are often accompanied by a reduction in capacity, mainly due to a lack of enabling technology in this field.

Therefore, the objectives of Sourdine II have been set at the development of new procedures and supporting technology:

- Development of new advanced and innovative environmental friendly approach and departure procedures. The results from the Sourdine I project will be used as an initial input.
- Provide an accepted implementation plan by all involved stakeholders to be able to migrate from the current situation to advanced environmentally friendly approach and departure procedures. This avoids the need to develop specific local solutions to a European problem.

- Development of enabling technology to achieve the successful introduction of the selected departure and approach procedures, such as ATC controller tools, automated aircraft-ATC interaction and cockpit monitoring tools
- Achievements will consist of quantified results for each procedure in terms of safety, capacity and environmental benefits, as well as associated costs or benefits. Objective evaluation of these issues will be performed by comparing controller and pilot workloads during baseline scenarios, i.e. current day, with future procedures. Metrics to be used will be in line with standardised European metrics and stakeholders' metrics.
- Produce tools for policy makers to provide insight into the relation between safety, the environment, efficiency and financial aspects.

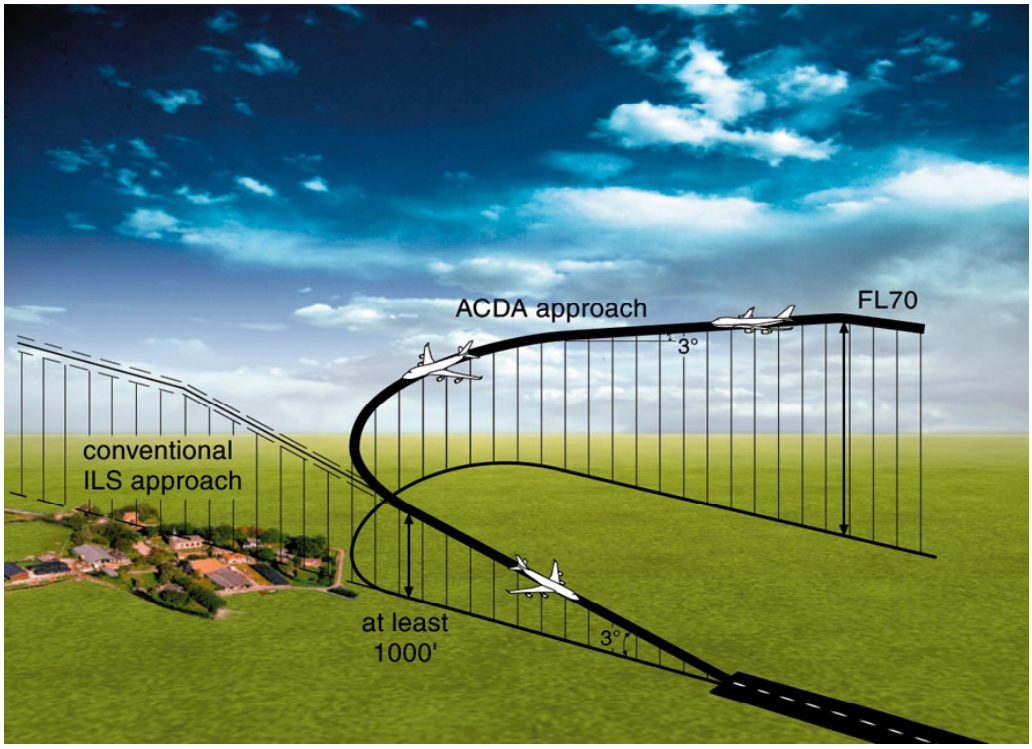

Figure 1 Impression of an Advanced Continuous Decent Approach (ACDA)

B4.3 Benefits of selected technical approach

The active involvement of delegates from all involved parties, i.e. airlines, airports, authorities, aircraft and ATM industry and research, either through expert panels or as a partner in the consortium is the only way to successfully achieve the desired goals. This is mainly due to the very sensitive nature of the entire issue of noise reduction as well as the associated costs, capacity and safety implications to the parties involved. Involvement of all concerned parties is therefore the only way to ensure agreement on the selected approach and to enable operational acceptance during introduction of the new methods and procedures.

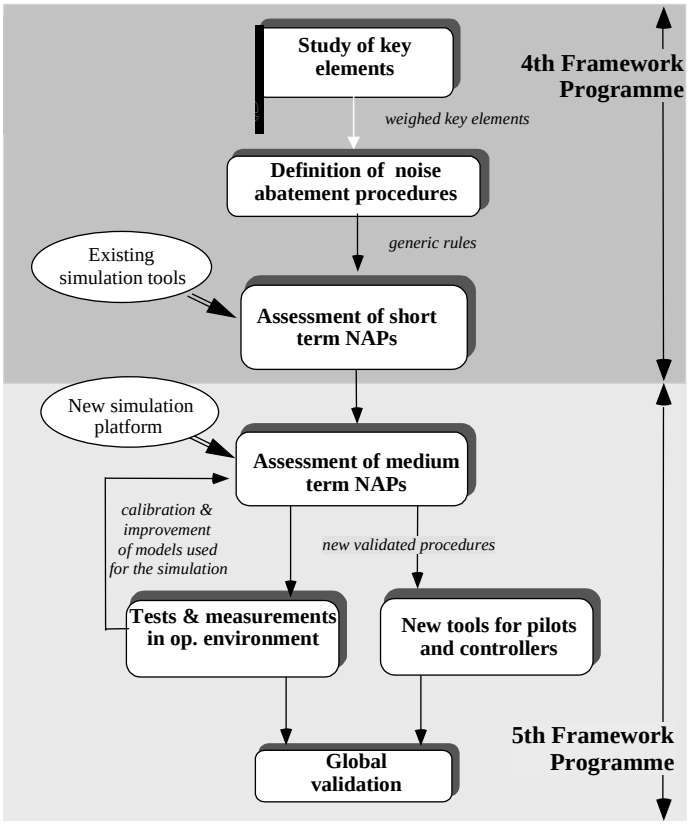

Figure 2 Methodology defined in Sourdine I

The development process of the promising environmentally friendly procedures will specifically be divided into different stages in order to avoid resources and effort being wasted on procedures and tools that would be regarded as unacceptable by end-users. Therefore, in order to arrive at an end product, i.e. tools or operating procedures, that will be environmentally friendly, yet safe, efficient and financially acceptable, the following stages will be gone through:

- Brainstorm sessions using expert judgement of all involved parties
- Initial assessment of important aspects in terms of capacity, cost, safety and environmental benefits, by means of fast time simulations, cost studies, assessment studies. Legal and certification aspects are to be looked at as well.
- Detailed manned evaluations of the concepts with respect to safety, workload and capacity, using real-time simulations with ATC and aircrew interaction. This is done to ensure acceptability from end-users
- Preparation for phased introduction into operational use

If necessary the above steps have to be repeated in an iterative manner, which will enable the consortium to converge towards an operational procedure with high probability for acceptance by the end-user community.

The above implementation plan should prevent a too great technological step being made and subsequently phases the introduction process according to user standards. ***In the short term this will provide guidance and quantifiable benefits, in the longer term this will provide innovative, advanced procedures.***

See also B5.1 for a more detailed description of the methodology.

B4.4 Main innovations from the proposal

The main innovation emanating from the Sourdine II project will be the proposed implementation plan that will lead to the operational introduction of advanced environmentally friendly procedures. This operational introduction will be performed in phases, to allow stepped introduction of the newly developed technology and tools. To achieve this, the project will yield a number of enabling technologies and tools:

- Improved guidance, control and monitoring tools to be used onboard aircraft allowing the safe and efficient execution of the noise abatement procedures
- ATM tools to enable efficient and safe planning and monitoring of air traffic arrivals and departures using the newly developed noise abatement procedures
- Improved and more detailed aircraft noise data and models, which need to be available to accurately compute the environmental impact of specific operating procedures. Current noise models and methods are not accurate enough to compute the impact on airport noise when applying such procedures. In addition, many existing noise impact calculation models are tailored for aircraft operating procedures applied in the United States, whereas the European airports and airlines apply different procedures and have different fleet mixes. The production of noise and performance data relating to aircraft in European fleet mixes will be a significant part of the Sourdine II project.

B4.5 Contributions to the overall programme and future RTD actions

The major contribution to the overall 5FW GROWTH programme will be the provision of enabling technology and methods that will allow continued air traffic growth and mobility while enabling the environmental impact to the community to remain at a tolerable or decreased level.

B4.6 Appraisal of technical risk

Due to the complexity and multi-disciplinary nature of the matter as well as the number of parties involved, the success of the project will depend on the acceptability for EACH involved party of the study results for ALL aspects to be researched. The establishment of good teamwork between the stakeholders is therefore critical, and will be supported by the brainstorm and review phases of the project. Additionally, the inclusion of an expert panel will further reduce the risk of producing an unacceptable implementation plan for any party within the project. This will be supported by decision milestones, which allow external advice and reconsideration from the user community, as well as the EU, to be included.

Technical difficulties within the development process are foreseen to be the following:

- Insufficient, and insufficiently accurate, data are available to calculate the environmental benefits. This risk will be mitigated by the involvement of all major aircraft manufacturers within the project, either as a consortium partner, or as an external partner
- Maturity/Availability of the operational tools to be used by the end users, i.e. ATC as well aircrew. These tools will be developed during the project. Although part of the technology will be based on existing tools and methods without technical difficulty, a number of newly developed functions will need to be developed which may pose some risk during development should the evaluations by the end user prove to be unacceptable.

Those risks as well as other less major risks will be addressed in the project management plan. Moreover, the expertise of the consortium and its experience with conducting large R&D and procedure development will keep the technical risk to a minimum.

B5. Project workplan

B5.1 Description of the workplan

The technical approach that is developed for the Sourdine II project aims at optimally fulfilling the objectives of the project stated in B4.2. To make this happen, the project workplan is designed to:

- maximise usage of existing results and currently existing facilities
- define a thorough validation methodology comprising all factors and ensuring relevant results
- use an iterative approach including brainstorm techniques to ensure optimal and innovative new procedures
- ensure realistic results through the use of fast time and real time simulations and a variety of tools to simulate and calculate the effects on e.g. noise, emissions, capacity and finances
- include the participation of an expert panel to include all stakeholders aspects
- definition of an implementation plan for the new procedures and a policy tool to enable direct and optimal usage of the projects results

The workplan can roughly be subdivided into two parts, see figures 3 and 4. The first part aims at the development of new validated procedures and controller/pilot tools. After the new procedures have been developed, part two will focus on preparing the implementation of these new procedures. During the second part, an implementation plan will be developed to enable the transition from current day procedures to the new procedures. In addition, a policy tool will be developed which will visualise the relationship between safety, capacity and environment of each procedure to the policy makers.

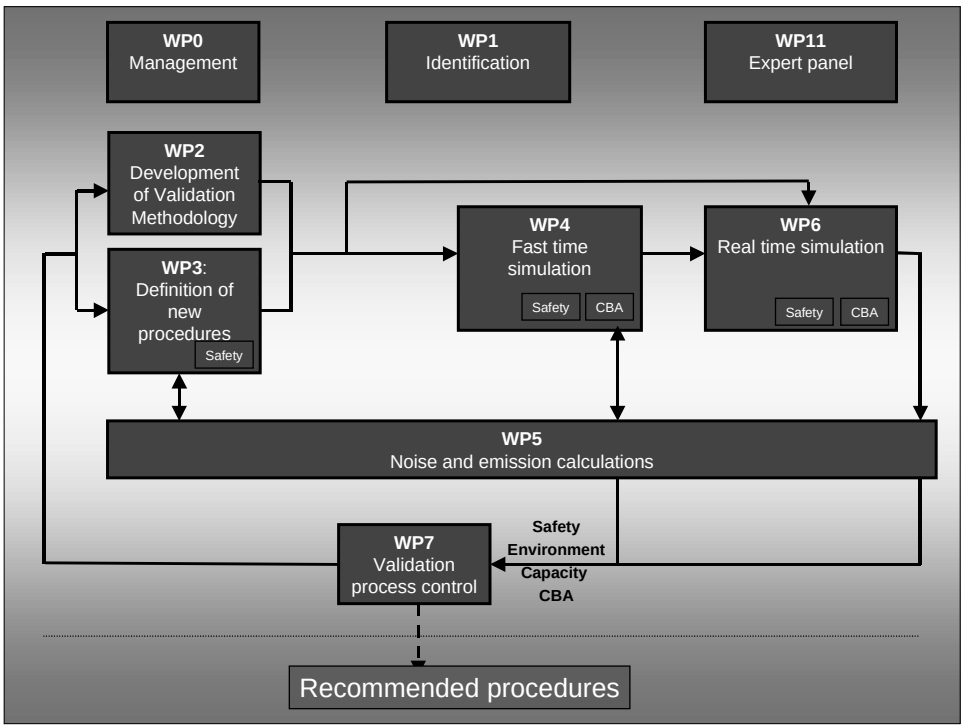

Figure 3 Development of new procedures

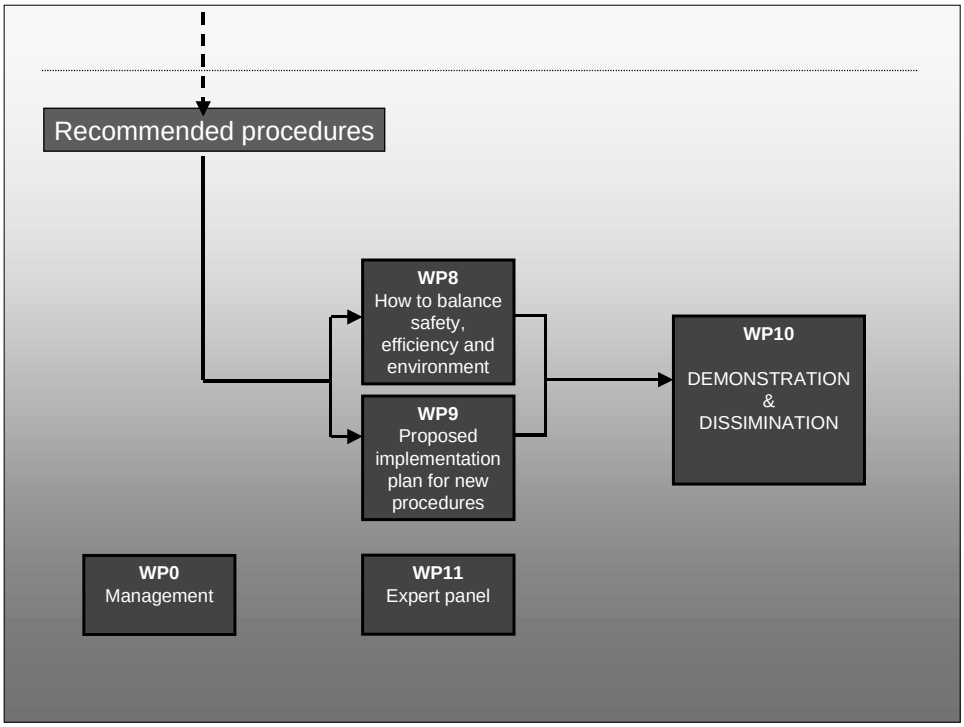

Figure 4 Preparation for the implementation of the new procedures

The Sourdine II project consists of 11 work packages, each comprising tightly related activities. A high level description of the work packages is found below.

The **project work package 0**, ***Management***, will be active during the entire project. The main goal of the management work package is to assure project progress according to the planning, control the quality and delivery of deliverables on time and control the various (and total) budgets in the project. Within the work package, the project co-ordinator will communicate and co-ordinate with the EC and other projects, programmes and thematic networks. The project co-ordinator will work in close co-ordination with the technical manager, who is focussing on the technical progress of the project. In this work package, in the beginning of the project, an exploitation manager will be appointed to produce an exploitation plan during the project.

In **work package 1, *Identification*,** a number of activities will be performed to provide background information for the development of the new procedures (WP3) and the implementation plan (WP9). These activities involve:

- review of already available relevant "noise oriented" projects and programmes (including a list of successful practises with benefits and disadvantages)
- making an inventory of current and future ATM/CNS and avionics technologies
- making predictions for the future operational environment in terms of traffic mixes and traffic loads
- making an inventory of present and future regulations and laws.

This work packages will be finalised 6 months after the project initiation to be able to provide inputs for the brainstorms on new procedures.

Work package 2, *Development of Validation Methodology* is initiated at the beginning of the project and will finish after one year. This work package will develop a Validation methodology based on the 5FW MAEVA project. This methodology will define the metrics and validation requirements for the new procedures, at each level of validation: for the expert sessions (or brainstorms), fast time simulations and real time simulations.

Work package 3, *Definition of new procedures* is the core of the project in which the new innovative procedures and supporting air traffic controller and pilot tools will be defined. First a review of current noise abatement procedures and other project/programmes will be made. Subsequently, two types of brainstorms will be organised: the first type to define the *ultimate procedures* for the *longer term*. The second type to define the *intermediate steps* to migrate from *current day* operations to the *longer term* procedures. The expert panel will support these brainstorms to include all stakeholders aspects.
After the brainstorms, initial analyses on noise, capacity and safety will be performed to select the most promising procedures and tools. The brainstorms are repeated after the results of the fast time simulations and real time prototyping of the tools have been delivered. This is done to refine the procedures and tool definition and selection.

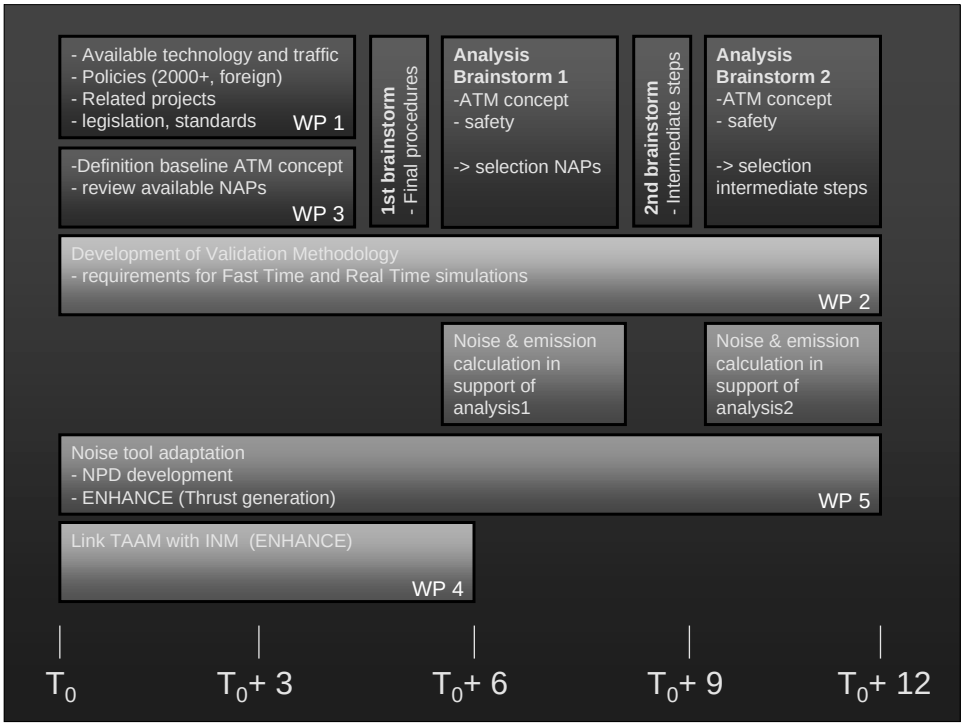

Figure 5 Activities in the first year of Sourdine II

In **work package 4, *Fast Time Simulation***, the new procedures will be evaluated, through fast time simulation, for different types of airports (small, medium and large). The results of the fast time simulations will be evaluated (according to the validation methodology) on capacity, efficiency, safety, noise, emissions and financial aspects. The results of the fast time simulations will be used to refine the procedures and tool definition and selection. These results will be used for the next step in the validation process: the real time simulations (WP6).

When necessary, a second run of the fast time simulations will be performed near the end of the project. The second run can use the results of the real-time simulations to improve the modelling of tools and air traffic (management) in the fast time simulator.

To reduce the necessary time for the fast time validation trials (which was found very large during other projects), automatic links will be developed between fast time simulation tools and the noise and emission tools.

In **work package 5, *Noise and emission modelling***, the necessary support for the validation trials will be provided for the noise and emission area. First of all, currently available noise and emission tools and databases will be adapted to enable estimations of the noise and emission impact of the new procedures during both the fast and real time validation trials. Furthermore, the new procedures defined in the brainstorms of WP3 will be evaluated on noise.

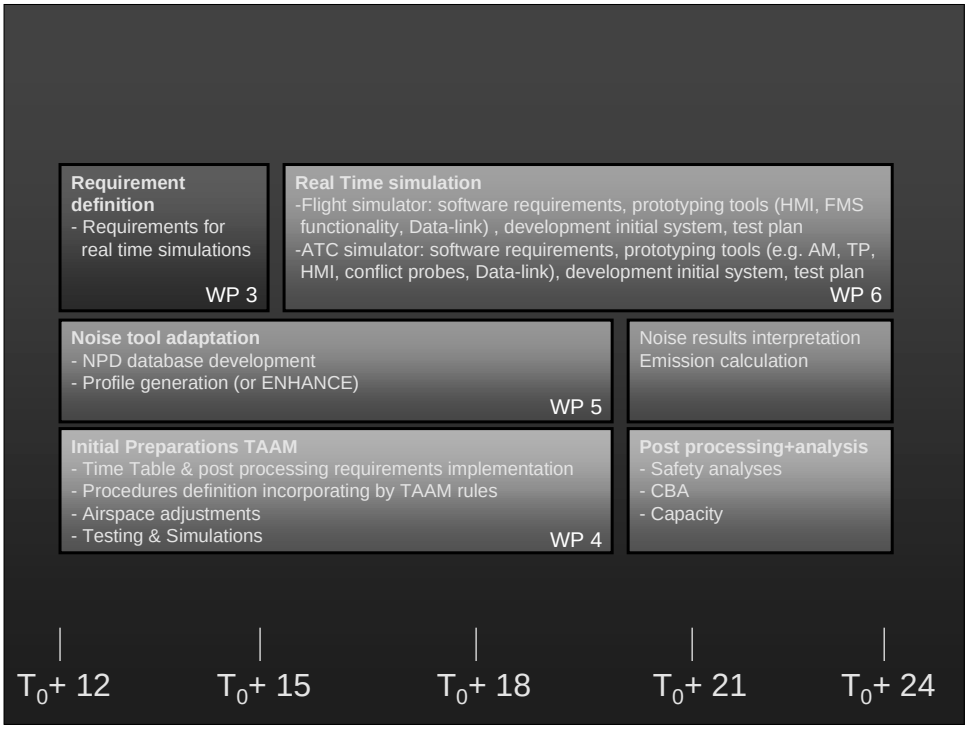

Figure 6 Activities in the second year of Sourdine II

In **work package 6, *Real Time Simulations,*** the new procedures will be validated using a real time ATC simulator and flight simulator. These simulations will investigate the feasibility of the new procedures and tools from the air traffic controller and pilot point of view. First of all, prototyping actions will be performed to develop the necessary tools based on the outcome of the brainstorms in WP3. After the detailed procedures are available (last brainstorm in WP3), and the tool prototypes are mature, measured simulations will be performed according to the validation methodology. The results will be analysed on safety, workload, capacity, noise, emissions and financial aspects (e.g. estimated costs for new tools).

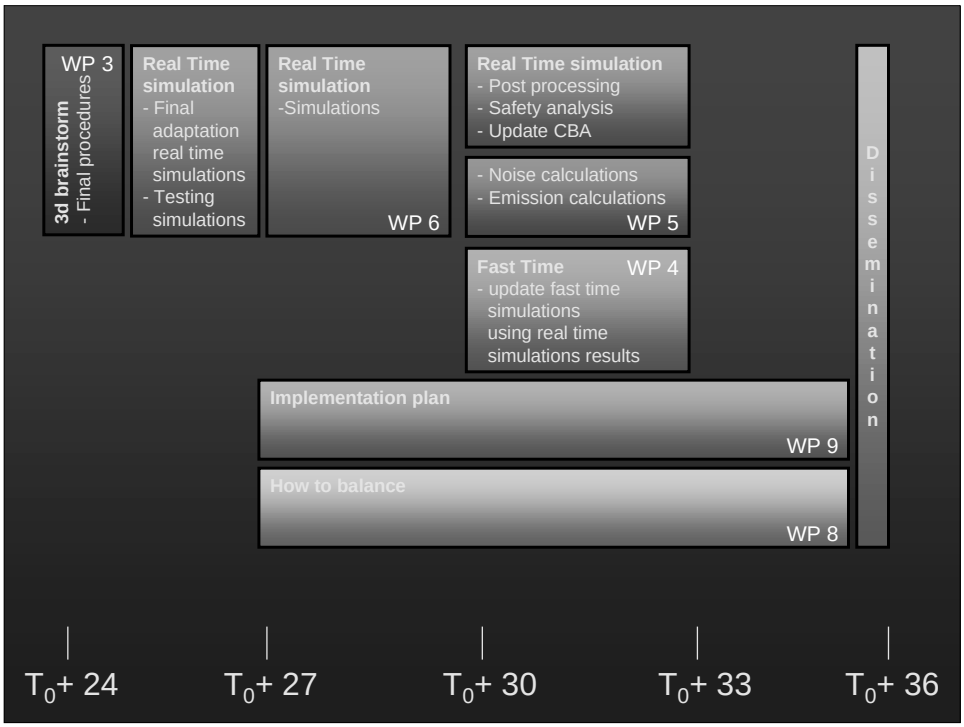

Figure 7 Activities in the third year of Sourdine II

Work package 7, *Validation process control*, will comprise all activities necessary to ensure that all validation activities will be performed conform the validation methodology.

In **work package 8, *How to balance safety, efficiency and environment***, a tool will be developed for policy makers to assess, for the different procedures, the relationship between safety, capacity, efficiency, environment and financial aspects. This tools is primary a visualisation of the results of the validation trials.

Work package 9, *Proposed implementation plan for NAPs*, will define, in co-operation with the expert panel, an implementation plan to migrate from current day operations to the advanced and harmonised environmental friendly procedures. This is the main results of the Sourdine II project. The implementation plan will cover all aspects related to the implementation of new procedures and tools, from legislation, financial aspects and development of certified tools until training.

Work package 10, *Dissemination,* will cover all activities necessary to disseminate the results from the Sourdine II project to all the involved stakeholders. These activities comprise (amongst others) the organisation of seminars, workshops and demonstrations. Moreover, documents will be produced and web-sites will be maintained.

Work package 11, *Expert panel*, will comprise all activities to organise the expert panel and to produce the meeting minutes from the expert sessions.

B5.2 Consortium composition

The SOURDINE II consortium consists of FOUR research institutes to provide technological input and simulation support, ONE aircraft manufacturer providing primarily noise modelling expertise and TWO ATS-service providers providing operational expertise. Furthermore, TWO engineering companies provide technological and financial expertise. Five countries are involved in the project.

The Sourdine II consortium composition is based on the fact that in addition to the consortium partners, an expert panel will be set-up. The reason for this construction is the following: the acceptance of the proposed implementation plan for the new procedures (main objective of Sourdine II) requires the support of many different organisations (Airlines, ATS-providers, Airports, CAAs, Industry etc.). Involving all these organisations would result into an unmanageable consortium with far too many partners. Therefore, the expert panel/consortium solution has been chosen: the consortium to 'do the work' and the expert panel to provide feed-back.

To ensure commitment of the expert panel to the project, all the involved experts have been contacted in advance. Most of them have already expressed their intentions to participate in the expert panel.

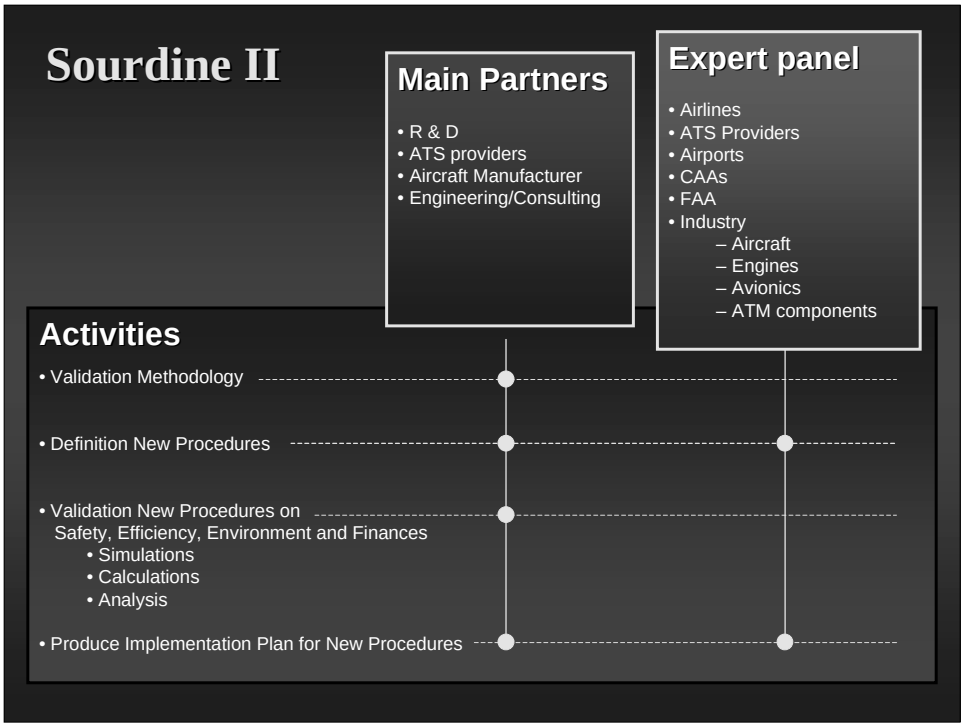

Figure 8 Overview of Sourdine II project and roles for partners and expert panel

CONSORTIUM OVERVIEW			
Participant		**Business activity / Main Mission / Area of activity**	**RTD Role in project**
Activity code	Nr.		
REC	1	National Aerospace Research Institute	• WP leader “Management” • WP leader “Real Time Simulation” • Co-ordinator project • Safety assessments • Real-time simulations (air and ground)
REC	2	National Aerospace Research Institute	• Noise & emission calculation
SER	3	Provider of air traffic control services	• WP leader "Fast Time Simulations" • WP leader “How to balance..” • Fast Time Simulations • Definition new procedures • Development of results presentation tool
SER	4	Provider of air traffic control services	• Review procedures and methodologies
IND	5	Manufacturer of aircraft	• Noise calculations • Review new procedures
OTH	6	Aerospace Research Institute	• WP leader “Noise & emissions calculations” • Definition validation methodology • Fast Time Simulation • Noise calculation
OTH	7	Engineering office	• WP leader “Validation Methodology” • WP leader “Validation process control” • Definition validation methodology
OTH	8	Engineering office	• WP leader “Definition new NAPs” • WP leader “Implementation plan” • Definition new procedures • Definition implementation plan • Support safety assessment
REC	9	Research and Development of advanced ATM Systems	• WP leader “Identification” • Fast Time Simulation • Cost Benefit Analysis

Activity codes: REC (Research Organisation), HES (High Education Institute), IND (commercial manufacturer, industry), SER (service provider, like for engineering services or consultant), OTH (all others, like standardisation bodies etc.)

B5.3 Gantt chart

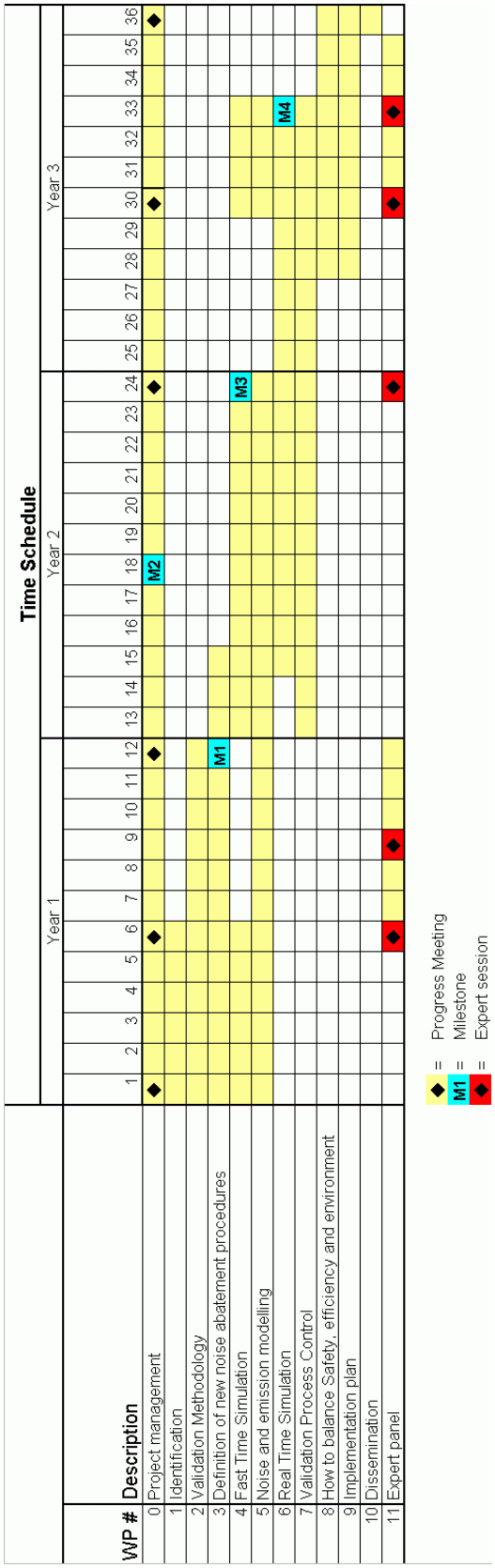

Table 1 Overview of activities in time

B5.4 Deliverables

OVERVIEW OF DELIVERABLES				
#	**Deliverable**	**Delivery date (start + months)**	**Output from W.P. Nr.**	**Nature of Deliverable and brief description**
1	D0-1	1	0	Project kick-off report and updated project management plan
2	D0-2		0	Board meeting minutes
3	D0-3	6,12,18,24, 30,36	0	Six-monthly progress reports
4	D0-4	12,24,36?	0	Cost statements
5	D0-5	3	0	Project quality plan
6	D0-6	30	0	Project exploitation plan
7	D0-7	12, 24	0	Intermediate results publications
8	D1-1	6	1	Report containing the results of the identification phase
9	D2-1	12	2	Validation methodology report
10	D3-1, section	12	3	Report describing the new noise abatement procedures
11	D3-1, section	25	3	Updated report describing the new noise abatement procedures based on last brainstorm
12	D3-2	15	3	Requirements document for the pilot and controller tools
13	D4-1	24	4	Report on the results of the fast time simulations
14	D4-2	32	4	Update D4-1 with results from additional fast time simulations
15	D5-1	3	5	Description of noise and emission modelling requirements.
16	D5-2	6	5	Description of noise and emission modelling methodology applied in SOURDINE II
17	D5-3	12	5	Results of optimisation and preliminary noise impact analysis
18	D5-4	24	5	Results of noise and emission impacts analysis of identified NAPs
19	D6-1	24	6	Prototyping results ATC simulator
20	D6-2	24	6	Prototyping results Flight simulator
21	D6-3	32	6	Real Time Simulation results
22	D7-1	32	7	Report presenting the results of the validation process control and the recommended procedures
23	D8-1	35	8	Policy Tool documentation
24	D8-2	35	8	Policy Tool
25	D9-1	4	9	Implementation plan
26	D10-1	36	10	Final document

B5.5 Milestones and decision criteria

OVERVIEW OF MAJOR MILESTONES			
Milestone No	Due date	Brief description of Milestone objectives	Decision criteria for assessment
M1	12	Definition of initial set of new noise abatement procedures	Required for the start of the Fast Time Simulations
M2	**18**	**Mid-term Review**	**Critical assessment of the new defined procedures, the validation methodology and the initial results of the validation process.** **During the Mid Term review, a 'decision to proceed' will be taken on the basis of progress, work to be performed, budget and constraints.**
M3	24	Finish of fast time simulations and real time prototyping	Required for the start of the last brainstorm sessions and the start of the real time simulations
M4	33	Finish of all simulations and post processing	Required to finalise all documentation of the project in time for the dissemination