PROGRESS REPORT

CONTRACT N° : **GRD2/2000/30228-S07.16812**

PROJECT N° : **GRD2-2000-30228-MAP**

ACRONYM : **SAMARIS**

TITLE : **Sustainable and Advanced Materials for Road InfraStructures**

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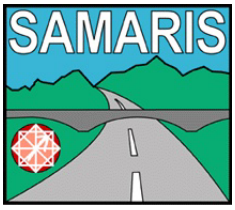
Competitive and Sustainable Growth (GROWTH) Programme



SAMARIS

Sustainable and Advanced MAterials for Road InfraStructure

PROGRESS REPORT – FIRST YEAR

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1. EXECUTIVE SUMMARY

Project SAMARIS is a merger of originally two project proposals: one dealing with issues of pavement research, the other with structures research, both applied to road infrastructure.

The pavement issues focus on the use of recycled materials in road pavements. Lack of answers to some key questions regarding their performance and environmental impacts is a hindrance to the full exploitation of these techniques, which potentially have a very important role in a sustainable road infrastructure. The project is aiming to provide some of these answers.

The structures part of the project deals with problems of maintenance of concrete structures, especially bridges, where cost-effective repair strategies are looked for, now more than ever, as many of these structures are ageing and traffic loads are increasing. The aim is to advance the testing of two high-tech repair techniques to the point where they can be available as maintenance options. At the same time the project is analysing the maintenance situation of highway bridges in a number of European countries, where such new techniques are badly needed.

The project's kickoff meeting with participation by all 23 contractors was held in January 2003 in Paris. The main activities of the next months were targeted on the Inception Report, which was submitted by the end of June. The work package teams got organised and their work on some early tasks was initiated. The Management Group established the norms and principles for the deliverables including a system for quality assurance. The first version of the project's internet home page became operational, and the Reference Group of End Users was formed.

In June 2003 the entire project organisation met at EPFL in Lausanne to consolidate and agree on the Inception Report, which was particularly important in view of the very long gestation period of the project, during which its context and situation had shifted somewhat. This event was also the occasion for the first meeting with the Reference Group of End Users, who were given an overview of the plans and aims the project and responded with very valuable observations that influenced the work on the Inception Report. At the same occasion a member of the FORMAT project, with which SAMARIS is clustering, was given the opportunity to present the plans and aims of that project.

With the Commission's approval of the Inception Report work in all work packages was then intensified and has proceeded as planned for the remainder of the year.

Several of the pavement research work packages started by issuing questionnaires to countries and organisations in order to establish the existing situation. The responses were slow in coming in and that has caused some delays in the schedules of these work packages. The delays, though, are not seen as risks to the overall time plan for the project.

The survey of the bridge maintenance situation in six selected countries has proceeded satisfactorily, and it is planned to extend this survey to some additional countries in Eastern Europe, where the bridge maintenance issue has the same priority.

The technological research in both parts of the project has progresses without delays and – in the case of the research on high-performance fibre reinforced cementitious concrete – even produced remarkable results that have been subjected to the first, external peer review of scientific gatherings.

The supply of the high-tech materials and the need to have access to the inventors' knowhow and knowledge about these materials required special attention. Problems were solved through Consortium Agreements that give satisfactory protection and confidentiality to these material properties.

Thus, the results of the first year of work give reason to expect that project SAMARIS will be able to attain its goals on time and within the budget as funded by national stakeholders and - for the large majority of participants - the Commission.

2. OBJECTIVES AND STRATEGIC ASPECTS OF THE PROJECT

2.1 Overview

The SAMARIS project was planned in response to the European Commission's call for proposals addressing Task 2.2.1/18 'Road Infrastructure Materials' of Key Action 'Sustainable Mobility and Intermodality' under the GROWTH part of the 5th Framework Programme for Research and Technological Development. The project pursues two separate lines of research and development, as described in the two sections below, which have the same end users, the maintenance planners of public and private road owners and the industries that serve them, but which are otherwise not interconnected.

An important feature of the project is therefore its *Reference Group of End Users*, which comprises road administration officials as well as industry representatives. This reference group follows the project from its start to the end. It will be kept informed about progress and results throughout the project and should have the familiarity with the outcome and the potentials to be able to take the steps to implementation in practical maintenance.

The pavement stream of work packages is improving our basis for using other than virgin materials for pavements without reducing demands for their quality, safety and durability, which will lend significant practical support to the policy of sustainable road technology. The other line of research in the project deals with some key problems of the securing a long service life of the concrete structures on the road network. It takes two novel and potent techniques through a testing and developing programme that shall give them main roles in a revised and optimised strategy for bridge and structure maintenance.

Thus, both lines of research address key issues of asset management that are of great importance for balancing costs with the benefits of sustainable technology.

2.2 The pavement project stream

A key objective of the pavement project stream is to encourage the use of recycled and secondary materials in pavements by detailing how such materials shall be selected, tested and where they should be placed into the pavement structures, in order to secure satisfactory performance, environmentally as well as functionally. Attention is given to the situation in Central European countries for which the RETRA-EST programme has identified recycling and use of alternative materials in pavements as a first priority for co-operative actions.

Another key objective, also supporting the case for more and better use of recycling and alternative materials, is to prepare for the harmonisation of European approaches of material specification within the next generation of CEN standards. This involves moving from a recipe approach, which puts much emphasis on the intrinsic characteristics of the constituents, to a performance-based approach, focussing on the in-place products that allow consideration to be made irrespective of the type of material.

Hence, this part of the project has the following technical and scientific objectives to:

1. Produce a general methodology for the assessment of functional, safety and environmental aspects for the use and re-use of any kind of material taking into consideration the actual context of use. The originality is the consideration of the material interactivity with its environment in the assessment process.
2. Define testing protocols for investigation of hazardous components when considering the re-use of pavement materials and draft an environmental annex to CEN products standards.
3. Develop mechanical models and test methods in order to derive performance-based specifications related to functional properties, for the wide range of materials issued from recycling policy.
4. Produce technical guides and recommendations for a proper use of recycling techniques in road construction.

The scientific and technical work plan is structured in four work packages which are closely inter-related to produce the expected results (see further).

Innovations introduced in this project stream require combining expertise from a variety of disciplines: pavement, material and environmental engineering. From a scientific point of view, the different tasks require competence in physic-chemical analysis, mechanical testing, development of constitutive models and of numerical models of pavement behaviour, pollution transfer, etc. The very practical objectives of a better use of primary materials and by-products also necessitate that the technological aspects be correctly addressed with expertise in material processing and techniques of recycling. Participating in the four work packages are R&D institutes, engineering consultants, university laboratories, product manufacturers and road contractors, representing 17 partners from 11 European countries including 2 CE countries. This group is complemented by one research organisation from the U.S.A.

Outputs from this part of the project will permit a more efficient use of local aggregate and of by-products, which directly contributes to EU's policy for sustainable development. Recommendations on recycling techniques will benefit both road authorities and the construction profession through fewer cases of failure due to inappropriate processing or construction methods and through more cost effective road works. They will help CE countries for a more efficient use of recycling in upgrading the existing networks. Moreover, work on specification will represent a direct input to CEN for the next generation of European pavement product standards.

2.3 The structures project stream

The structures stream objectives were setup to answer the 2 task descriptions from the call that addressed highway structures: to develop guidelines and specifications for use of innovative intervention techniques and to provide an updated inventory of highway structures in selected EEA and CE countries. The key objective of this part of the project is therefore to support the EU policy to improve the maintenance of highway structures through radically improved efficiency and durability of repair methods, resulting in reduced number of necessary road closures. This will considerably reduce the associated costs and increase users'

and workers' safety. Special attention is given to the Central European countries that are joining the EU in 2004, especially as condition of the highway structures there differs from the situation in the current EU member states. Therefore, the structures part of the project has the objectives to:

1. Draw together the requirements for a sustainable maintenance strategy which satisfies the functional, safety, economic and environmental requirements for highway structures.
2. Investigate the applicability of two innovative techniques, (the corrosion inhibitors and the high performance fibre reinforced cementitious composites), to be used for maintenance of bridges, tunnels, embankment, culverts and retaining walls at different levels of corrosion attack of the reinforcement.
3. Update and analyse the inventory of highway structures in the selected EEA and CE countries.
4. Propose methods and procedures for improved maintenance of highway structures.

The scientific and technical work plan is structured to give clear answers about the applicability of innovative materials and to obtain the state of the highway structures in selected countries. To produce the results expected by the task description, the project work plan is structured in four technical work packages, described in section 3.2.

The following strategic aspects are seen:

1. Improved knowledge about the new materials and better assessment procedures will considerably reduce costs of maintenance of highway structures.
2. Reduced need and duration of rehabilitation work on highway structures will result in more efficient road network by mitigating the unsafe and congestive effects of this activity on road traffic.
3. The 'highway structures' engineering profession will be given a basis for the practical use of the 2 innovative materials and techniques for maintaining and constructing structures which aim at reducing dramatically future durability problems.
4. Highway infrastructure managers will benefit from the verified assessment tools and guidelines for the new maintenance strategies.
5. For the first time ever highway structures in some Central European countries will be analysed in a comprehensive comparative way.

3. SCIENTIFIC AND TECHNICAL PERFORMANCE

3.1 The pavement project stream

3.1.1 Overview

To reach the set of objectives considered in Samaris pavement stream, this one has been divided into four technical work packages addressing the following tasks on the whole duration of the project :

WP3: Assessment of alternative materials to produce a methodology to assess the eco-compatibility of materials in road pavement design.

WP4: Safety and environmental concerns in material specifications to incorporate these aspects in product standards and to develop the associated testing protocols.

WP5: Performance-based specifications to address functional properties for a new generation of specifications for pavement materials (within the frame of this project this task is focused on permanent deformation aspects for the prevention of rutting in bound and unbound pavement layers).

WP6: Techniques for recycling to draw recommendations from the many different approaches to recycling that have been tried, with various degrees of success, within Europe, with particular attention paid to the situation in CE countries.

Besides, a coordination work package (**WP2)** was included at the beginning of the project, from January to July 2003 in order to refine the definition of the work programme to be done into each of the technical WP of the pavement stream.

Thus in the following one will find the state of the progress performed during the first year of this project in each of these work packages. On the whole it shows that the overall plan has been quite fairly adhered to until now and that the main goals defined for year 2003 have been attained. The teams in each work package are now well teamed despite the large number of participants in some of the WPs, the programs and objectives are clearly defined, the methodology and tools (e.g. environmental scenarios, mechanical models) have already been refined or selected, the choice of "generic" materials on which to focus, which is difficult and important in the wide world of alternative and re-used materials, has been made.

Among the most significant technical progress of year 2003, one can make the following list:

WP3: Responses to a questionnaire sent to the different European countries, asking for their re-cycling practice, technical and regulatory documents have been received and analysed. This has made it possible to produce on time deliverable D4, which constitutes an original and rich state-of-the art report on existing specific national regulations applied to material recycling.

WP4: to be completed

WP5: The choice and collection of data of well documented full scale experiments on pavements has been done. The models (empirical & advanced ones) for the prediction of rutting have also been selected.

Now it will make during the rest of the project to assess the performance approach (material testing +models) considered in SAMARIS for the prediction and prevention of rutting, induced from permanent deformation, induced either in unbound or bound materials.

WP6: to be completed

3.1.2 WP 2: Elaboration, integration and review of the work programme

3.1.2.1 Refine the definition of the work programme of the pavement stream

Work done in 2003

This task was done between January 2003 and July 2003. It ended as as planned by the production of the part of the Inception Report related to the pavement stream.

This work made it possible to achieve that the work programme covered by the 4 technical other work packages of the Pavement stream were considered within a common, integrated approach. In particular, the definitions and end dates of the surveys needed for the different WPs had to be co-ordinated for efficiency and to minimise discontinuities.

The Lausanne meeting (June 2003) with the Reference Group of End Users produced some remarks on the programme which were taken into account and thus made it possible to check that the needs were correctly considered.

I addition, some contacts were taken with FORMAT's (Fully Optimised Road Maintenance) European project consortium to study the possibilities of clustering with SAMARIS objectives (see section 6.4).

3.1.3 WP 3: Assessment of alternative materials

The period January-March 2003 was dedicated to the finalisation of the working programme. A contribution to Task 4.3 (Environmental annexes to product standards) in 2005 was demanded by WP4, and agreed by some WP3 partners (DHI, ECN, UNH and LCPC). The time allocated to this task will be deduced from WP3 (0,5 man-month per partner).

3.1.3.1 Task 3.1: Review of present approaches

Work done in 2003

During the two years that elapsed since the agreement by the European Commission of the proposal of SAMARIS, the situation regarding European standardisation on building materials and on environmental protection has evolved considerably. The WP3 group decided therefore to modify slightly the content of Task 3.1 with regard to what was initially proposed in the SAMARIS project. This task remained dedicated to a review of present approaches, but lead to a new definition of deliverables D4 and D9. The objective was to obtain a better knowledge of the state of the art for material assessment in the perspective of recycling in a

large number of European states today, and to make an analysis of the present national documents (legislation, standardisation, research) in a comparison with international documents.

This led to a re-definition of contents and planning of deliverables D4 and D9, which was agreed by the EC. D4, entitled "Existing specific national regulations applied to material recycling", was postponed to month 12, while D9, "Analysis of European and international documents", was maintained for month 15.

To prepare D4, a questionnaire was issued during the Spring of 2003 and sent to all SAMARIS member countries in July. Responses from 7 states (Austria, Denmark, Spain, France, Slovenia, Sweden and the Netherlands) were obtained and analysed during Autumn and early Winter 2003. Questions were oriented toward 9 alternative materials and 5 road applications (see Task 3.2).

The work towards D9 started during Spring 2003 with the gathering and analysis of documents related to engineering properties: European standards, COST actions, OECD reports, EC RTD programmes, documents from USA (ASTSWMO, FHWA, UNH) and other research papers. The same work on the same kind of documents, but related to environmental properties, started during Autumn 2003.

Deliverables and Milestones

The information from the D4 questionnaire replies were compiled into a draft report for Deliverable 4 which was completed for review, validation and approval on time (December 2003). It is structured as follows:

1 – Introduction

2 – Regulation

3 – Material definition, status, economy and use

4 – Material management documents

5 – Conclusion

The conclusion of Deliverable 4 highlights the variety of practices across Europe as regards assessment of alternative materials, with some great lacks for some materials, but it also shows some local expertise which could be activated in the development of an integrated engineering/environmental assessment methodology.

The information gathered for the physical and engineering elements' part of D9, have led to the compilation of a first draft during Autumn 2003, structured as follows:

1 – Introduction

2 – Physical and engineering elements

2.1 – Knowledge in European papers (a – general information and recommendations; b – existing frameworks from research documents; c – information from CEN standardization work; d – research needed and problems to be solved)

2.2 – Knowledge found in other (international) papers (a – general information and recommendations; b – existing frameworks from research documents; c – research needed and problems to be solved)

3 – Chemical and environmental elements

3.1 – Knowledge in European papers (a; b; c; d ditto § 2.1)

3.2 – Knowledge found in other (international) papers (a; b; c ditto § 2.2)

4 – Synthesis (will benefit from original inputs from Milestone 7 (see task 3.2)

5 – Conclusion

3.1.3.2 Task 3.2 Definition of the assessment methodology

Work done in 2003

A proposal for a rational use of alternative materials in road construction must be the result of a comprehensive analysis of the possible performance of any such material implemented in a given situation (called use scenario). For this analysis, a methodical approach must be adopted to scan the field of all the possibilities, avoiding missing any important ones, so as to make possible some relevant and argued simplifications. The objective is to try to provide the simplest possible management tool to end-users.

The development of the assessment methodology has to take into account two *a priori* conditions. One is linked to the road usage functions which have to be fulfilled by the materials and the external factors which these road usages have to face. The other one is linked to pre-existing frameworks of assessment (and/or design) in the field.

The road usage or application is a fundamental element of the use scenario as it will directly determine the dominant factors acting on the recycled material. Taking into account various typologies of road structures and their own experience, the WP3 members have agreed to define 5 applications: surface course; road base; sub-base; subgrade; shoulders and landscaping. This typology is close to the COST 337 one, but takes also into account elements from the FHWA framework.

Complementary to the literature review, as a first step, the purpose of Milestone 7, entitled "Influent parameters and their range of variation in applications", was to collect information associated to questions such as: which function each application is expected to fulfil?; under which types and magnitudes of "stresses" (or "factors") ?

During the period 2000-2002, improvements have been made in the development of methodologies for evaluating materials. For the functional properties in general, some COST actions and the AMADEUS project are of interest. It is also the case of some other international research for the evaluation of leaching properties of alternative materials. Lastly, an interesting evaluation framework for recycled materials dealing with both engineering and environmental aspects, was proposed by the FHWA in 2001.

Keeping in mind that the philosophy of SAMARIS is oriented towards practical road maintenance and construction, a pragmatic goal is to propose to end users a methodology which is directly usable, at least for a limited number of materials. Considering their present use, the possible engineering and environmental problems they cause, and the amount of available pre-existing knowledge on them, 9 materials were chosen : MSWI bottom ash; coal fly ash; road crushed concrete; building demolition crushed concrete; blast oxygen furnace slag; electric arc furnace slag; crystallised blast furnace slag; vitrified blast furnace slag; decontaminated soils.

To prepare Milestone 7, a questionnaire was issued during Spring 2003 and sent to all SAMARIS countries in July. Responses from 4 states (Austria, Denmark, France and Sweden) where obtained during Fall and Winter 2003. Questions were oriented toward the 9 alternative materials and the 5 road applications.

The WP3 group agreed that the most comprehensive pre-existing approach today, is the FHWA 2001 "Framework for evaluating use of recycled materials in the highway environment". The WP3 group agreed to start by an assessment of the procedures and tests proposed in this framework for the 9 materials and for each of the five road applications. A "material sheet" listing the problems posed by each material is currently being written with inputs by all WP3 members. According to their relevance, some tests of the FHWA framework or their European equivalent, will be rejected or kept. The remaining ones will constitute a first "skeleton" of the methodology. To this skeleton will then be added relevant complementary tests from other more specific assessment frameworks identified in D9.

Deliverables and Milestones

The information from the M7 questionnaire replies were compiled into a first draft during December 2003. The milestone, due December 2003, is delayed and should be passed in March 2004 when an internal (not contracted) report on the M7 questionnaire is completed. The framework of this internal report is the following:

1 – Introduction

2 – Development of a methodology for the assessment of alternative materials' environmental and mechanical durability in road construction

3 – Functions provided by road applications

4 – External factors acting on road applications

5 – Internal factors acting on road applications

6 – Measured values for the 9 WP3 alternative materials

7 – Conclusion

No deliverables are due in 2004 for task 3.2

3.1.4 WP 4: Safety and environmental concerns in material specifications

3.1.4.1 Task 4.1 Detection of hazardous components in materials to be recycled

Work done in 2003

The approach to detection of hazardous components was reviewed and it was decided that, in order to be inclusive, any procedure would have to identify the nature of the hazard rather than just specific components that are known to be hazardous. However, certain components that are known to have been used in asphalt and which would need care in recycling, such as tar and sulphur, would still need to be explicitly covered.

The main situations where hazards due to component materials could be expected to occur were identified as being the following:

A. Materials that produce fine particles when pulverised during milling off and/or crushing that are hazardous when ingested.
B. Materials that produce hazardous fumes when heated during mixing.
C. Materials that approach or exceed their flash point during heating.
D. Hazardous materials that could be leached out of the pavement after construction.

In addition, there may be other hazards not considered, requiring a fifth category of "E, Materials that present other hazards".

A questionnaire was prepared about information known about, and test methods used to determine, hazardous materials under the various categories described above in different member states. The questionnaire was deliberately kept short, with the following questions raised:

1. Country to which your information relates?
2. Are there regulations or guidelines about what road materials can or cannot be recycled?
3. What substances are prohibited or have severe restrictions?
4. Are there any tests available for potentially hazardous materials?
5. Do you have any ideas for potentially hazardous materials that should be looked at?
6. Do you have any further information (or comments or useful publication references) about hazardous materials in pavement recycling?
7. Please provide contact details of people who you think might be in a position to provide information on this subject in your country.

Responses were received from ten countries (Hungary, Belgium, Denmark, the Netherlands, Sweden, Iceland, Germany, Austria, France and the United Kingdom).

A literature search was undertaken on recycling asphalt when hazardous component materials can be present with particular emphasis on test methods. Whilst there are a lot of references to recycling asphalt of which several made reference to potentially hazardous component materials, there was very limited quantitative information. Furthermore, very few test methods for detecting such components were found, either in-house or formerly standardised methods.

Deliverables and Milestone

The information from the questionnaire replies and the literature review were compiled into a draft report for deliverable D7, "State of the art report on test methods for the detection of hazardous components in road materials to be recycled". In addition, a simple flow-chart intended to form the basis for a procedure to check for hazards when using alternative component materials in asphalt has been included to help identify the gaps, in terms of available test methods, there are before implementation is possible.

The deliverable was due in October 2003 but is not expected to be delivered until the end of February 2004, depending on the time found necessary for the review, verification and validation procedures required for SAMARIS outputs to be completed for this report.

The milestones associated with deliverable D7 is M8, Literature review on test methods for detection of hazardous components, and was due in December 2003. The criterion was that the collected information will determine the topics for which tests protocols need to be developed, refined or adjusted to the context of pavement works. The milestone has been met

with the draft report, and work is now underway to decide how to fill the gaps most expeditiously.

3.1.4.2 Task 4.2 Reaction to fire of pavement materials

Work done in 2003

The primary objectives from this phase of the work programme on the reaction to fire of pavement materials were:

1) To identify, by means of a questionnaire, any Regulatory requirements for the reaction to fire performance of pavement materials are currently in use within Europe.

2) To carry out a literature review looking at Regulations outside the European Union.

3) To identify and review any relevant fire incidents.

4) To identify and review reaction to fire tests that are either currently used to assess the reaction to fire performance of pavement materials or those which may be suitable for this application in the future.

The first stage of the project involved the identification and distribution, via the SAMARIS project co-ordinator, of a questionnaire targeted at Regulators and those involved in the specification of this type of material. As well as distributing the questionnaires, a copy was also provided for inclusion on the SAMARIS web site.

The key questions were:

1) Are there any requirements or regulations relating to the fire performance of pavement or road surface coverings either in your country or within your area of responsibility? If so, please provide any relevant details or references.

2) Do you use or are you aware of any current or draft test methodologies for pavement materials in your country or within your area of work.

3) If the answer to either of these is no, would you consider developing or adopting methods for dealing with this issue if an area of concern was identified.

4) Do you consider pavement surface coverings as potential fire risks? If you have any relevant data or statistics relating to fire incidents where these materials have been identified as a contributory factor we would be grateful to receive them.

The response to this questionnaire has been extremely limited. Only one member state was identified having any Regulatory requirements, but despite requests to the responder, no additional details have been forthcoming. Therefore, it has been concluded that a limited follow up activity be undertaken and this is now ongoing.

The review of the other regulatory bodies has not identified any requirements for reaction to fire tests for pavement materials.

A review of fire incidents in which the pavement material has been involved has been undertaken and the test method review document discusses their implications in detail.

Deliverables

The test method review has been completed and the results have been reported as part of a separate output. The main conclusions show that no separate test method has been identified

but a number of options based on existing test methods are being considered. The first draft of deliverable D8, "Review of road authorities' positions on reaction to fire of pavement materials", is in preparation and should be delivered early in 2004.

3.1.4.1 Task 4.3 Environmental annexes to product standards

The task is not due to commence until August 2004, so there is nothing to report at this time.

3.1.5 WP 5: Performance based specifications

3.1.5.1 Task 5.1 Data collection of field experiments and accelerated loadings tests

Task 5.1 consists of data collection from well-documented field experiments and accelerated loading tests on test-tracks for calibration and validation of models.

Work done in 2003

WP 5 has for the models on permanent deformation for unbound granular material and bituminous materials decided to divide them - either developed or found in literature – together with their associated laboratory protocol(s) into three levels:

1. Routine level
2. Advanced level
3. Research level

The first two levels are considered as being within the objective of SAMARIS, while the last level is clearly outside as the models on this level - even in the near future - only will be for research or for very special, stand alone projects that would not be the normal practise for the end-users' group. This distinction has been one important factor in the search for collecting data for the database, but if candidates providing documentation for advanced level models will normally also provide data for routine level.

WP 5 has also sought to find field tests and accelerated loading experiments (FT&ALEs) that incorporate traditional materials and alternative materials. Unfortunately it has not been possible to find well-documented candidates for FT&ALE incorporating alternative materials. One potential candidate was found but the final data showed up to be unsatisfactory. The possible reasons why possible candidates are so few will be discussed. At least for the bituminous bound materials there is a way to compensate this through selection of the large scale tests which are to be scheduled for be performed later in the project. Through this the original intention and fulfilment of objective of Samaris is judged to be obtained.

WP 5 has also hoped to find FT&ALEs that could provide data for both material types from the same experiment, which would facilitate not only modelling of the materials but also the whole pavement structure as a whole. No well-documented experiment could be found to deliver this within the other limitations imposed on the candidates

Work in progress

The main activity presently is reporting on the development of the database as the report is due at the end of March 2004 (Deliverable D6).

Deliverables and Milestone

No deliverables in 2003. First and only deliverable on this task is called D6 and is expected on time in the end of March 2004 (Month 15 of SAMARIS project period). First Milestone M9 in April 2004 will evaluate the database and the need for additional data to be collected.

Strategy to obtain objective

So far WP 5 is confident that the selected FT&ALEs for database will provide the sufficient input for calibration and validation of the models when the large scale experiments in the Danish Asphalt Rut Tester can supply additional data on asphalt materials incorporating alternative materials.

3.1.5.2 Task 5.2: Permanent deformation of granulated unbound materials

Work done in 2003

Literature study on and development of models on permanent deformation in unbound granular materials has been preformed. Models and associated laboratory protocols has been assessed. An extensive laboratory programme has been planned for achieving material parameter from one of the FT&ALEs in order to provide the needed input data for the selected models.

Work in progress

Reporting on the activities in 2003 with respect to assessment of the models and associated laboratory protocols is in progress as the report is due at the end of March 2004 (Deliverable D10). The planned laboratory programme started ultimo 2003 and is expected to continue for approximately the first half of 2004.

Deliverables and Milestones

No deliverables in 2003. First deliverable on this task is D10 and is expected on time in the end of March 2004 (Month 15 of SAMARIS project period). First Milestone M14 in April 2004 will evaluate the need for additional tests for validation of the models for permanent deformation in unbound materials in flexible pavements.

Strategy to obtain objective

WP 5 is confident that models evaluated for permanent deformation of unbound granular materials will have the sufficient capability of prediction the behaviour of the material. These models can then facilitate suggestions for performance-based specifications

3.1.5.3 Task 5.3: Rutting of bituminous mixtures

Work done in 2003

Literature study of state of the art on models and laboratory protocols for permanent deformation in bituminous materials have been performed and evaluated. The chosen models are representing different approaches for the prediction of permanent deformations in bituminous layers; rheological models are discussed as well as plasticity models and models based on multi layer theory. That way the wide variety of calculation methods within rutting is pointed out.

A tool (Excel spreadsheet) for presenting the needed input data for the further analysis has been developed.

Work in progress

Reporting on the activities in 2003 with respect to assessment of the models and associated laboratory protocols is in progress as the report is due at the end of March 2004 (Deliverable D11).

Deliverables and Milestones

No deliverables in 2003. First deliverable on this task is D11 and is expected on time in the end of March 2004 (Month 15 of SAMARIS project period). First Milestone M15 in April 2004 will evaluate the need for additional tests for validation of the models for rutting in bituminous layers.

Strategy to obtain objective

WP 5 is convinced that with help of selected data the calibration and validation of the chosen models for prediction of permanent deformations in bituminous layers will be possible. Whether any additional laboratory tests are needed will be decided in April 2004 (M15).

3.1.6 WP 6: Techniques for recycling

The aim of the two tasks of Work Package 6 is to provide up-dated information and recommendations about techniques and applications of recycling. It is organised in two tasks:

3.1.6.1 Task 6.1: Elaboration of a technical guide on recycling techniques

The objective of this task is to produce a technical guide on recycling techniques. Its purpose will be to assist road authorities in using or increasing their understanding of the possible applications of by-products and highlight the issues that need to be evaluated when considering their use as identified from the analysis made.

The task started in March 2003 and has to be completed in September 2005. In the development of this task the following deliverables have to be produced:

- D5 : Report on literature review on recycling of by-products in road construction in Europe (date due March 2004)
- D12: Report on recommendations for mixing plants for recycling works (June 2004)
- D29: Technical guide on techniques of recycling (date due: September 2005)

Work done in 2003

Work was undertaken on deliverable D5: “Literature survey of recycling of by-products in road construction in Europe”, which will contain one chapter on literature analysis and another one on digest of technical information by by-product are included. The document will provide a list of conclusions and propose the format for a *Technical Guide on Recycling Techniques.*

A first draft of D5 has been produced including the analysis of the starting documents:

- *Recycling Strategies for Road Works* (OCDE).

- *Recycled Materials in European Highway Environments: Uses, Technologies and Policies* (FHWA).
- *ALT-MAT: Alternative materials in road construction* (EC)

The selection of by-products to be considered has been done in conjunction with WP3 and also taking into account the advice from the End Users Group, following the Lausanne meeting. These are:

1. Steel slag (basic oxygen and electric arc).
2. Air cooled blast furnace slag.
3. Coal fly ash.
4. Mining waste rock (colliery spoil).
5. Ground granulated blast furnace slag.
6. Scrap tyres.
7. Coal bottom ash.
8. Building demolished by-products.
9. Municipal solid waste incinerator bottom ash.
10. Waste glass.
11. Foundry sand.

The first draft of D5 includes a digest of technical information about the recycling of four of these materials: air cooled blast furnace slag, coal fly ash, ground granulated blast furnace slag and coal bottom ash.

The content of the digest still has to be supplemented with the information coming from other WPs and also coming from other countries than those included in WP6.

Work was also started on deliverable D12: "Recommendations for mixing plants for recycling works" (due June 2004)

This deliverable is being developed by EUROVIA and RSG 90 on the basis of their own broad experience on recycling.

In a first draft of the report, EUROVIA has included information on:

- Building, civil engineering and roadway demolition material.
- Municipal Solid Waste Incineration Bottom Ash.
- Blast Furnace Slag.
- Foundry Sand.

For each of these by-products, specific information is included on the origin, characteristics, possibilities of recycling, potential uses and applications, quality control of the process, technical standards and technical references.

For this deliverable RSG90 has produced a first draft of the document *Recycling of C&D waste in Denmark, State of the art.* It is planned to complete a general description of recycling C&D wastes and slags in Denmark, together with the working process for the handling. Moreover, a general overview of the recycling of others residues in Denmark will be included.

3.1.6.2 Task 6.2: Review of the situation of Central European countries

This task is being developed by teams from TUBrno in the Czech Republic and from IBDiM from Poland. It was started in March 2003 and must be completed in August 2004. It must poduce deliverable *D15: Situation on recycling in Central European countries (date due: August 2004).* Work in the task began with the production of a questionnaire to collect information about the situation in these countries, based on the questionnaire used in the OECD (1997) report.

A first list of recipient countries, institutions and contact people was produced, including: Czech Republic, Slovakia, Poland, Hungary; Slovenia, Estonia, Letonia, Lituania, Serbia-Montenegro, Croatia, Macedonia, Ukraine and perhaps Russia, Rumania and Bulgaria.

The emission of the questionnaire, follow-up of the answers and the analysis of the information has been divided between TUBrno and IBDiM each a group of countries.

TUBrno has sent the questionnaire to Hungary, Slovakia, Slovenia and Bulgaria. At the end of December 2003 the complete answer was achieved only from Slovakia. Partly filled questionnaire was obtained from Slovenia, and the answers from Hungary and Bulgaria are under preparation. Beside TUBrno is directly working on the answer for the Czech Republic.

For its part, IBDiM has received answers to the questionnaire from Ukraine and Russia.

3.2 The structures project stream

3.2.1 Overview

The aim of the structures stream is to evaluate the applicability of advanced materials and techniques for the rehabilitation of highway structures, to provide guidelines for their use and to setup an updated inventory of highway structures in selected EEA and CE countries.

Highway structures (bridges, tunnels, culverts and earth retaining walls) make up a substantial proportion of the fixed assets of the land based transportation network of Europe. They are vital elements in the road network and the imposition of restrictions on their use, such as lane closures or weight restrictions or even complete closure, may have severe economic and political consequences. The most common reason for restricting the use of a structure is deterioration of the structural elements. The economic consequences can also be serious with heavier goods vehicles often being forced to make considerable detours and in some cases being completely excluded from some areas.

To achieve the specified objectives, the project is built around four work packages, three deal with two specific techniques (corrosion inhibitors and high performance fibre reinforced cementitious composites - HPFRCC) and the fourth one with the survey of highway structures in selected countries. Work accomplished during the first 12 months of the project can be summarised as follows:

- WP12 on *Strategies for rehabilitation of highway structures* has, with assistance from other work packages, compiled the relevant part of the Inception report and has prepared a draft report on other work on the development of strategies for the rehabilitation of highway structures.
- WP13 on *Corrosion Inhibitors* has been mainly working on the state of the art reviews, on selection of materials to be investigated and on the first experiments, conducted in several laboratories.
- WP14 on *HPFRCC* has been mainly working on *Preliminary study*, which covered literature surveys, but also exploitation and experimental testing and numerical modelling for the analysis of test results, and on *selection of materials* for the main test series.
- WP15 on *Survey* has produced a questionnaire on highway structures that was sent to the selected countries, has worked on loading, including the first experiments in Poland, and performed literature reviews on condition and structural safety assessment procedures for highway structures.

Detailed progress of each work package is given below.

3.2.2 WP 12: Strategies for rehabilitation of highway structures

3.2.2.1 Task 12.1: Description of the problem

The objectives of this task were to:

- produce an Inception Report
- define scientific QA procedures
- review of methods available for the rehabilitation of highway structures.

An Inception Report was produced which gave a detailed breakdown of the research that will be carried out under Work Packages 12, 13, 14 and 15. It built on the description of work given in the original submission and provided a detailed plan for the research that will be undertaken over the duration of the project. The Inception Report also included detailed QA procedures for an independent audit to ensure that Deliverables are to the required standard and meet the objectives of the project.

Existing reports on methods for the rehabilitation of highway structures were reviewed. The most recent report was produced as part of COST 345 (Procedures Required for Assessing Highway Structures). In the UK, TRL has recently published an application guide on the "Repair of concrete highway bridges – a practical guide." These reports have provided background information for the SAMARIS project and will enable identification of the types of repair for which the two methods being investigated in this project could be applied. No report is required for this Task but the existing reports on this subject provide a source of information that will be available to the project (M2).

3.2.2.2 Task 12.2: Review of other work

The objectives of this task were to:

- review of strategies for rehabilitation
- selection methods for rehabilitation

A review was undertaken of published work on the development of strategies for the rehabilitation of highway structures and a draft report has been made available (M6). A number of general models have been developed for making decisions on repair/replacement at the network and/or bridge level. As part of the Bridge Management in Europe (BRIME) project, a framework was developed for the management of bridges which enabled these structures to be maintained at minimum overall cost. The BRIME project highlighted two theoretical maintenance strategies that were particularly relevant to the selection of the optimum maintenance repair strategy. These were the models proposed by F.A. Branco and J. Brito of the University of Lisbon, and by D.M. Frangopol of the University of Colorado. Building on the principles outlined in these two models, the BRIME project developed a method for selecting the best maintenance option for a bridge, taking into account such factors as the safety, durability and functionality of the bridge and the cost of the maintenance option. In the UK the Highways Agency (HA) has developed procedures for the preparation, assessment and selection of maintenance options on a whole life cost basis using a computerised Bid Assessment and Prioritisation System (known as BAPS). In 2003, the Nordic network for repair and maintenance of concrete structures (NORECON) issued a draft report entitled “Decision and requirements for repair” which examined maintenance strategies for concrete structures.

A review was also undertaken of work carried out under the REHABICON project to consider how non-technical issues could be taken into account in the decision making process. This adds a new dimension to the problem, as it is not possible to quantify many of these issues in monetary terms. This makes it difficult to balance a cost saving on the one hand against the need to, say, extract raw aggregates on the other.

The selection of the actual methods for rehabilitation is usually obtained directly from the models referred to above. Most models consider the impact of all the available rehabilitation methods and identify the most appropriate.

3.2.2.3 Task 12.3: Development of guidelines

A start has been made on the development of guidelines. The initial emphasis is on collection examples of case studies and information on how decisions are currently taken in European countries.

3.2.3 WP 13: Corrosion inhibitors

3.2.3.1 Task 13.1: Basic mechanism study

The fundamental objective of Task 13.1 is to determine the influence of corroded reinforcement state on corrosion inhibitor concentration requirement by studying the mechanisms of passivation due to inhibitors. The project objective for the period was to conduct research in simulated pore water.

Progress is being made on differentiating between inhibitor action on clear steel surfaces and on corroded surfaces.

It was planned to perform measurements in simulated pore water and in mortar/concrete specimens. Although the measurements could be done in parallel it was decided to prioritise on the former initially because the results inform some of the investigations on concrete. Studies were made on whether the corrosion action was based on chloride immobilization or not. The focus of the study is based on the next generation of inhibitors, yet to be released to the market.

Several reported investigations have shown that organic inhibitors can hinder corrosion of steel in simulated pore water solution and that reduction of steel corrosion in concrete is possible. However the mechanism of passivation processes due to the inhibitors is not completely clear. Possible mechanisms of passivation are bounding of chlorides to the quaternary salt, and formation of the passive film due to adsorption of the amino group on the steel surface. Addition of the inhibitors to pore water solution formed some gel-like complexes and it is speculated that the penetration of chlorides, oxygen, and water is thereby reduced.

The activities for the next period will involve investigation of corrosion behaviour in concrete and mortar specimens.

3.2.3.2 Task 13.2: Chloride and inhibitor concentrations

The fundamental objective is to explore the potential existence of an effectiveness envelope bounded by the ratio of chloride to inhibitor concentration. The project objective for the period was to conduct a literature review, select and procure test equipment, design concrete mixes, cast specimens and commence testing.

The mix designs to be used were determined in association with trials conducted as part of Task 13.3 (see Section 3.2.3.3). Two mixes are being used. The first mix, ‘Mix D’ has a high paste volume and a high water/cement ratio (0.63) to accelerate inhibitor migration and yield results in as short a time scale as possible. The proportions of cement, fine aggregate, and coarse aggregate are 1.0:2.26:2.83. The maximum aggregate size is 10 mm. ‘Mix F’ is more representative of concrete encountered in service. It has a maximum aggregate size of 20mm and a water/cement ratio of 0.65. The proportions of cement, fine aggregate, coarse aggregate (D10) and coarse aggregate (D20) are 1.0:2.89:2.5:2.71.

It was planned to conduct experiments using both amino alcohol and sodium monofluorophosphate inhibitors. Future commercial developments are such that it was decided to revise this to exclude sodium monofluorophosphate inhibitors but to look at two generations of amino alcohol inhibitors. The majority of tests will be conducted on specimens coated with current generation inhibitors but tests will also be done with the next generation of inhibitors currently under development. Literature reports on monitoring corrosion in the presence of inhibitors were reviewed and, as expected, half cell potential monitoring was less favoured than linear polarisation resistance. An order was placed for a Force Technology GalvaPulse device, following confirmation of availability of matching funding. Samples were cast with incorporation of gritblasted reinforcement. Water absorption tests were commenced prior to chloride ponding. The tests will later involve determination of chloride and inhibitor concentration at the reinforcement. This requires knowledge of information confidential to the manufacturer. This information is to be made available subject to completion of a Confidentiality Agreement. This was prepared over a lengthy period as it required consultation with legal experts in several jurisdictions before an agreed text was circulated to

the SAMARIS partners. It had not been fully cleared by the consortium by year end. Sufficient stock of corrosion inhibitors have been supplied for use in the programme.

A literature review indicated that corrosion inhibitors are more likely to be effective in reducing corrosion due to carbonation than that caused by chlorides of moderate to high concentrations. This may equate to concentrations of 1.5% and greater than 2.0% respectively, chloride by weight of cement.

Activities for the next period will prioritise on conclusion of the Confidentiality Agreement, followed by a lengthy programme of cyclical chloride immersion allied to corrosion monitoring and concentration determinations.

3.2.3.3 Task 13.3: Concrete permeability

The fundamental objective is to examine the potential existence of an effectiveness envelope bounded by concrete permeability values. This will be achieved by quantifying the rate of penetration of the inhibitors into concretes representing a range of permeabilities and by investigating the relationship of permeability testing to degree of penetration. The project objective for the period was to review the literature, agree the details of the laboratory programme, cast and condition specimens, and commence monitoring.

A review of test methods was conducted to identify suitable test methods to measure the ease by which corrosion inhibitors may penetrate concrete. It was concluded that the ISAT test be used as the primary test with a gas permeability test as secondary. Trials mixes were cast and the mix designs to be used were determined. Three mixes are being used, all of which have a high paste volume by limiting the maximum aggregate size to 10mm. In addition all have high water/cement ratios: 0.74, 0.63 and 0.56 for Mix A, B, C respectively. ‘Mix A’ has proportions of cement, fine aggregate, and coarse aggregate of 1.0:2.64:3.30. ‘Mix B’ has proportions 1.0:2.26:2.83 and ‘Mix C’ has proportions 1.0:2.0:2.5.

Satisfactory conclusion of the trial mixes and discussions with the other partners of Work Package WP13 resulted in Milestone M3 being achieved on schedule. The initial stages of the laboratory programme were completed but progress to the next stage requires knowledge of information confidential to the manufacturer. This information is to be made available subject to completion of the Confidentiality Agreement referred to in Section 3.2.3.2 and this was not in place by year end, thus delaying the programme. Therefore, in respect of Deliverable D17 it is planned to conduct experiments using the current generation of amino alcohol corrosion inhibitors, but not sodium monofluorophosphate inhibitors. Tests using the next generation of inhibitors currently under development will be considered but are unlikely to be completed in time for Deliverable D17. Results may be available to inform discussions on Deliverable D25. Current generation corrosion inhibitors have been supplied for use in the programme.

The literature has little quantifiable information on the influence of permeability but does note that diffusion appears to be the most important transport mechanism for amino alcohol inhibitor penetration – much more so than capillary suction.

Activities for the next period will involve a major programme of testing, once the Confidentiality Agreement is in place. The implications of the confidential information on the assets required for tracking inhibitors may require sharing of resources between partners in the Work Programme. This will be urgently assessed when the confidential information is released.

3.2.3.4 Task 13.4: Influence on mechanical properties

The fundamental objective is to determine the relative influence, if any, of migrating corrosion inhibitors on seven selected properties of mature concrete. The project objective for the period was to conduct a literature review, agree the details of the laboratory programme, cast specimens and commence testing.

The mix designs to be used were determined in association with trials conducted as part of Task 13.3 and were aligned with those of Task 13.2. Two mixes will be used: 'Mix E' and 'Mix F'. 'Mix E' is similar to 'Mix C' but uses natural, as opposed to sea-dredged aggregate.

Details of the programme (test methods and geometry of specimens) were determined except for tracking inhibitor presence and concentration. This information is to be made available by the supplier subject to completion of the Confidentiality Agreement referred to in Section 3.2.3.2. Appointment of an additional postgraduate student for the task, casting of specimens and commencement of trials was postponed until the Agreement is in place.

Adequate stock of current generation corrosion inhibitors has been supplied to date for use in the programme. Some tests will also be done with the next generation of inhibitor.

A literature review revealed information on the influence of inhibitors on compressive strength and freeze/thaw resistance but little is published on the other five properties to be investigated.

Activities for the next period will concentrate on concluding the Confidentiality Agreement, appointing a researcher and conducting the tests in accordance with a revised schedule.

3.2.3.5 Task 13.5: Field trials

The fundamental objective is to monitor corrosion activity in rehabilitated concrete in the field. This will involve the monitoring of a bridge rehabilitated through application of amino alcohol inhibitors and limited field exposure trials on specimens identical to some of those used in laboratory trials in Task 13.2. The project objective for the period was to select and instrument a structure for monitoring and to cast specimens for controlled field exposure.

Existing highway structure case studies were reviewed. It became apparent that rehabilitation by migrating corrosion inhibitors is still at an early stage of market penetration in Europe, possibly due to the lack of research data on its optimal use. Rehabilitated car park structures are available for monitoring in the United States of America but a European highway structure is preferred for this project. Four rehabilitated bridges in the United Kingdom were identified but were not readily amenable for monitoring in the project. A corroding bridge structure in the United Kingdom has been identified for possible treatment and monitoring. The client, a borough council, is favourably disposed to its use in the SAMARIS project but details are not yet finalised of the rehabilitation programme. There is concern that the timescale involved in setting up the rehabilitation contract may degrade the quality of Deliverable D21 if insufficient data is generated in the time available for the trial.

Laboratory-cast specimens for the field exposure trial have been prepared. Corrosion inhibitors have been supplied for application when corrosion develops.

The final report of COST Action 521 on corrosion of steel in reinforced concrete structures was published in 2003. It states that it is too early to draw definitive conclusions on the use of surface applied inhibitors for maintenance and repair purposes. This results from the lack of

long term experience and scattered data. This situation reinforces the objective of SAMARIS Work Package WP13: to seek conditions of optimal, but not universal, use of migrating corrosion inhibitors on deteriorated structures.

Activities for the next period will concentrate on expediting the major field trial in the United Kingdom. Sika Ltd. are prepared to employ a specialist subcontractor, C-Probe Ltd., to conduct the monitoring. C-Probe Ltd. have a track record of pioneering work in this field in the U.K. and U.S.A. and could significantly reduce the time required to set up the experiment. This may involve negotiation to redistribute Sika's expenditure budgets. Lest the U.K. trial fall through, the Work Package leader will also be examining alternative limited field trials in Slovenia or Ireland. As a last resort, the possibility of garnering data from rehabilitated structures in the U.S.A. will continue to be considered.

Meanwhile the field exposure trial on laboratory-cast specimens will continue.

3.2.3.6 Task 13.6: Specifications

The fundamental objective of Task 13.6 is to prepare guidelines on the use of inhibitors in highway structure maintenance. The project objective for the period was to liase with the leader of Work Package WP12 to ensure that the deliverables of Work Package WP13 were compatible with the needs of Work Package WP12.

No subtasks were scheduled in the period.

A relevant report by Working Group 6 of COST Action 345 is nearing completion. The report, on remedial measures for highway structures, is likely to emphasise the significance of a structure's porosity and state of saturation on the effectiveness of migrating corrosion inhibitors. These issues are being addressed in the tasks supporting Task 13.6.

No specific subtasks will be activated until the first quarter of 2005 but during 2004 the Work Package leader will be assessing the progress and early outcomes of other tasks in Work Package WP13 to assess their ultimate influence on the quality and timing of Task 13.6's Deliverable D25.

3.2.4 WP 14: High Performance Fibre Reinforced Cementitious Composites

The objectives of this work package are to:

- Demonstrate the applicability and advantages of ultra compact HPFRCC materials (UHPFRC) for the rehabilitation of concrete road infrastructure components (including aspects of global life-cycle-cost in relation to WP 12).
- Make a first step towards the tailoring of these materials for various applications of rehabilitation.
- Provide guidelines for the use of these materials and their further optimisation (conceptual design, numerical simulation tools, test methods, limit state criteria for design, etc.).

WP 14 is divided into 5 tasks, as follows: 14.1 Preliminary Study, 14.2 Testing, 14.3 Interpretation – modelling, 14.4 Numerical parameter study, 14.5 Specifications – documents for application

3.2.4.1 Task 14.1: Preliminary study

The major effort in 2003 was dedicated to this task, according to the initial planning. It is split into 6 subtasks which cover literature surveys and exploitation as well as experimental testing and numerical modelling for the analysis of test results. Two milestones (M4- due date: end 2nd quartal and M12- due date: end 4th quartal) depended on the progress of this task and were passed on time.

Subtask 14.1.1: State of The Art Review (STAR)

An extensive review has been carried out in 2003 on the development of so-called high performance fibre reinforced cementitious composites (HPFRCC) and their applications. A first draft report has been issued with 69 pages including figures, tables and a comprehensive bibliographical list of references. To appreciate the benefits of fibre reinforcement, the mechanism of fibre action has been detailed, whereby work in the field of micromechanics has been included to give a fundamental understanding. This is followed by a review of the parameters influencing the behaviour of fibre reinforced composites.

HPFRCC is a generic term encompassing many different materials ranging from those that employ ultra-compact matrices and those that do not. However, the common point of all HPFRCC materials is their Hardening Tensile behaviour that helps control cracking to a much better extent than usual FRC (Fibre Reinforced Concretes). Within this report, details have been given on the various types of HPFRCC reported in the literature. A clear distinction can be made between on one hand *ECC (Engineered Cementitious Composites)* and *Slurry infiltrated materials (SIFCON, SIMCON)* with a rather permeable matrix, and on another hand *UHPFRC (Ultra High Performance Fibre Reinforced Composites)* which exhibit at the same time a significant tensile hardening behaviour and an extremely low permeability and which present the most interesting properties for the applications foreseen in WP 14.

Although the theoretical background, mix proportions and method of fabrication of various HPFRCC can be found in the literature, it has to be appreciated that material characteristics vary across different parts of the world. With this in mind, methods of obtaining matrices and composites of certain characteristics are discussed. *This, combined with knowledge in the micromechanical behaviour will enable the researcher or engineer to come up with a preliminary mix design using locally available materials, which is especially relevant for Central European Countries.*

Applications of HPFRCC to new structures, or for the rehabilitation of existing structures, were also documented and discussed. The STAR provides a sound basis for the main scientific work and gives direct support for the decisions to be taken regarding Milestones M4 and M12. It gives the overall context of the issues to be considered when applying new layers of HPFRCC on existing structures. The State of the Art Report on HPFRCC will be updated with the latest developments in 2004 and included in deliverable D13 due at the end of 6th quartal.

Subtask 14.1.2: Determination of the most significant phenomena – Milestone M4

On the basis of the literature study (STAR), experimental tests and numerical simulations, following phenomena were identified as most significant:

In fresh state: effect of the fibrous mix on the workability, effect of curing.

In hardened state: effect of the direction of casting (vertically as a wall or horizontally, as a plate) and of the layer thickness on the mechanical and physical properties; at early age: effect of viscoelasticity (relaxation) and of thermo-mechanical phenomena and autogeneous shrinkage linked to hydration of binders; at long term: effect of viscoelastic behaviour (relaxation and creep), effect of sustained loading or fatigue loading, effect of damage on the permeability of UHPFRC. The acute hydrophilic behaviour of UHPFRC, due to its extremely low water/binder ratio, and high quantity of unhydrated cement grains plays a very significant role in the water transport in permeability tests. Permeability tests with liquids inert towards cement hydration have to be performed to have a sound overview of the transport properties of UHPFRC in damaged state. Due to the very low permeability of the UHPFRC, the drying shrinkage should not be a significant cause of deformations at long term.

Subtask 14.1.3: Determination of solicitations in practical cases

A review has been started to evaluate the stress level at service state in usual highway structures in order to find comparisons with the limit states that will come from subtasks Permeability. This review is not yet terminated.

Experimental tests on fresh and hardened HPFRCC's

Three aspects have been investigated experimentally in order to select appropriate materials for the main test series:

Subtask 14.1.4: Effect of composition on properties in fresh state

The *properties in the fresh state* (rheological e.g. workability and susceptibility to a slope of the casting surface) served as a basis to define the range of possible applications for specific mixes. As far as possible, self-compacting materials were sought. Three different recipes of $CEMTEC_{multiscale}^{®}$ have been tested with various types of matrices in order to optimize their workability:

- The matrices of CM1 and CM2 could be fine tuned to obtain a self-compacting behaviour. Both mixes are robust and tolerate slopes till 5 %. CM3 was difficult to process and requires further investigations to be used.
- Further works will concentrate on CM1 and CM2 (milestone M12).
- A mix with synthetic fibres will be made available by LCPC in spring 2004 and tested y MCS.

Subtask 14.1.5: Effect of the geometry of the element to be cast (wall or plate) on the mechanical properties (tensile and flexural behaviour) and

Subtask 14.1.6: Effect of the composition of the fibrous mix on the mechanical properties (tensile and flexural behaviour on plates).

24 Tensile and 60 flexural tests were performed at an age of 28 days, on specimens with various thicknesses and orientations with respect to casting. Both tests were instrumented and designed in order to obtain the full pre and post peak response of the materials. The tensile tests (on notched and unnotched plates of 20 cm width, 5 cm thickness) deliver a direct comparison of the intrinsic mechanical performance for various mixes and conditions of casting. The main results of the test are the full stress displacement curve with the limits of

the hardening and softening domains which are the most reliable mechanical performance indices. However, due to the high requirements for this test, only a limited number of specimens could be tested. The flexural tests were performed as 4 PT bending on plates of 20 cm width, 42 cm span. Thickness of 10, 30, 50 and 100 mm were used to cover the range of practical applications. The result of this test is the full force-deflection curve. The interpretation of this test is less straightforward than that of the tensile test, owing to the non-linear behaviour of the HPFRCC in bending. It is however easier to perform than the tensile test and less time consuming. It helped investigate the scatter on the mechanical properties in bending and test various configurations with respect to the direction of casting and specimen thickness, to detect eventual anisotropy effects. Both tests showed a reasonable scatter of results, smaller for the tensile test. The peak stresses in tension and modulus of rupture in flexure corresponded to what was expected for all materials, except CM3 which was weaker. The extent of the tensile hardening domains could be determined for all materials and corresponded to the expectations, for having sufficient crack control. A strong effect of the direction of the major principal stresses with respect to the direction of casting (horizontal, as a plate or vertical as a wall) was detected. This effect will have to be considered for the design and application. It is not significant for applications on slabs. It plays a significant role for application of repair layers on walls and can be mitigated to a large extent by appropriate technological procedures for casting.

3.2.4.2 Testing

Milestone M12 *Selection of materials for main tests series* (subtask 14.1.2), due at the end of the 4th quartal, was passed on time.

1. For thin layers with only protective function, material with one single type of short steel fibres (5 mm long) – material CM1.
2. For medium layers with protective and eventual structural function (with or without reinforcement bars), material with short steel fibres of 10 mm, eventually combined with steel wool can be used. – material CM2.
3. For prefabricated elements, CM2, or if very high mechanical performance required, further investigations on CM3 needed.

Subtasks 14.2.6 and 14.2.7 Permeability of HPFRCC in damaged and undamaged states

The water permeability tests on undamaged and damaged UHPFRC materials (CEMTEC$_{multiscale}$®) and on concrete, were started in anticipation of subtasks 14.2.6 and 14.2.7 at MCS-EPFL. Comparative air permeability tests were performed between CEMTEC$_{multiscale}$® and concrete, on tensile specimens and on hybrid structural elements. The protective properties of the UHPFRC CEMTEC$_{multiscale}$®, *without any thermal treatment*, towards ingress of aggressive substances were confirmed by those preliminary water and air permeability tests.

3.2.4.3 Task 14.2: Interpretation – modelling

This task was not active during the reporting period (start in 5th quartal)

3.2.4.4 Task 14.3: Numerical parameter study

This task was not active during the reporting period (start in 8th quartal)

3.2.4.5 Task 14.4: Specifications – documents for application
This task was not active during the reporting period (start in 9th quartal)

3.2.5 WP 15: Survey of highway structures

3.2.5.1 Task 15.1: Data collection

After defining the work in the Inception report, the work of WP 15 started with collecting information about the highway structures in 6 selected countries from Central Europe (CE) and European Economic Area (EEA): Austria, Czech Republic, Hungary, Norway, Poland and Slovenia. The first step was preparation of the questionnaire which was based on some recent surveys on highway structures, done in the COST 345 action *Procedures for assessing highway structures* and in the PIARC committee C 11 on *Bridges and other structures.* Theses two questionnaire provided only limited data from the selected CE and EEA countries. In its first part, that deals with general information and condition of highway structures (bridges, culverts, tunnels and retaining walls) the WP 15 questionnaire is similar to the existing questionnaire to allow for combining the already available and new information. The last 2 chapters are completely new, seeking information for the Tasks 15.3 to 15.5 about the traffic loading safety assessment procedures. The draft questionnaire was discussed with the subcontractors during a meeting in Vienna in July, the final questionnaire was sent around in September and by the end of 2003 they were returned (milestone M 11 fulfilled). In 2004 it is planned to extend the mailing list to the countries which were not thought about in the project proposal, such as Baltic States and Croatia. A limited version of the questionnaire, containing only questions about traffic loading and structural safety, will be also sent to those countries that have already filled in the COST 345 or PIARC questionnaires.

3.2.5.2 Task 15.2: Condition assessment

Condition assessment task started with the literature survey. Among others it included documents of 4th FW project BRIME (Bridge Management in Europe), COST 345, PIARC committee C11, USA State Department of Transportations' reports, some national handbooks and instruction for condition assessment, etc.. Work continues in year 2004 with evaluation of the questionnaires and development of the Handbook of damages, an Internet application which will help inspectors to identify and correctly classify damages on highway structures.

3.2.5.3 Task 15.3: Loading

Loading of structures is an issue which during a structural assessment process is often not accounted for in the most optimal way. Task on *Dead loads* has only started its work with evaluation of existing procedures. Task on *True traffic loading* will evaluate existing and newly collected weigh-in-motion (WIM) data. WIM is the only way of collecting data that provides unbiased results and thus allows for reliable traffic load modelling. While collection of existing WIM data will start in 2004 based on information from the questionnaires, collection of new data was under way with the first of the two experiments. In October 2003 a bridge WIM system was installed on the Zakroczym bridge in Poland on the main road from Warsaw to Gdansk. Bridge WIM systems calculate speed, axle loads and the gross weight of the vehicles with the help of instrumented existing bridges, where sensors on the superstructures convert these bridges into measuring platforms. Deflections (strains) of the structures are the physical quantity needed to perform this operation. Measurements in Poland were unique as for the *first time ever*:

- a long span bridge (75-m main span) was used for long-term bridge WIM measurements and
- such measurements were done without installing axle detectors, as all required information was acquired only by the strain sensors installed inside the steel box girder; such approach considerably improves system durability (there is no direct impact of vehicles on sensors any more) and will as such have serious impact on future WIM measurements.

Results have been evaluated and will be used in the subtask Traffic load modelling.

The goal of the *Traffic Load Modelling* task is to improve the reliability of methods of assessing imposed traffic loading on bridges. Existing methods are inconsistent – they have been found to give different results depending on the assumptions adopted. Considerable progress has been made in improving existing methods. A major source of error in state-of-the-art methods has been the fitting of a bi-modal Gaussian distribution to the gross vehicle weight data. This gives a good fit on average but can be significantly inaccurate in the tail which can have very significant consequences. The measured histogram can be used as an alternative to fitting to a bi-modal distribution but there is always a problem of insufficient data in the tail. The solution proposed has been to use a "semi-empirical" distribution. This involves using the measured histogram directly where there is sufficient data for reliable information and fitting a curve through the tail. The difference in accuracy has been shown to be highly significant.

A visit has been made to Slovenia to collect a large database of WIM data. Work is in the early stages of initial analysis of the data by road type and region.

3.2.5.4 Task 15.4: Structural safety

Structural safety started with the state-of-the-art report on safety procedures used around the world. The major part of the work, which will be based on the results of the questionnaire, will start in 2004.

3.2.5.5 Task 15.5: Survey

The Survey Task is not due before 2005.

4. DELIVERABLES

4.1 Revised Classification of Deliverables

After having received the SAMARIS inception report by 30 June 2003 the Commission requested that a revised classification of all contracted deliverables was to be made and submitted to the Commission. The purpose was to facilitate the Commission's prioritisation of of the review and approval processes for the deliverables.

The rationale behind the classification is that the majority of the deliverables are representations of work which is necessary to produce the minority of deliverables which will contain the main findings that correspond with the aims and objectives of the project

A new classification was proposed and negotiated with the Commission and published as an internal project document dated 12 July 2003. This classification is found at annex VI.

4.2 Deliverables due and made in 2003

D1 due in March: Project web site (http://samaris.zag.si)

Delivered: Limited operational from March 2003. Functionalities added in following months.

D2 due in June: Inception report.

Delivered: End June 2003

D3 due in July: Project Brochure

Delivered: September 2003

D7 due in October: "State of the art report on test methods for detection of hazardous components in road materials to be recycled" was not submitted in 2003 by WP4. New due date is end of March 2004. Reason for delay was late incoming replies to questionnaire forming the basis of the work.

D4 due in December: "State of the art report on existing specific national regulations applied to material recycling" was not submitted in 2003 by WP3. New due date is end of March 2004. Reason for delay was late incoming replies to questionnaire forming the basis of the work.

4.3 Milestones due and passed in 2003

M1 due in March: Project web site fully operational with basic project information.

Not passed. Web site initially only limited operational. Became fully operational in June 2003.

M2 due in June: Complete review of repair methods for structures.

Passed in June.

M3 due in June: Decisions on properties of concretes to be used in laboratory and field test trials of corrosion inhibitors.

Passed on time.

M4 due in June: Identification of most important phenomena for defining HPFRCC main test programme.

Passed on time.

M5 due in June: Approval of scientific methodology and work programme for pavement stream work packages.

Passed on time.

M6 due in September: Complete critical review of R&D work relevant to strategies and methods for the rehabilitation of structures.

Passed in October 2003.

M7 due in December. Determine the influent parameters and their range of variation before developing the methodology for assessing the possibility of using by-products.

The milestone was not passed in 2003. Expected passage time is now March 2003

M8 due in December: Evaluation of existing test methods for detection of hazardous components and decision for the development of new tests.

The milestone was not passed in 2003. Expected passage time is now March 2003.

M11 due in December: Collection of structural data completed.

Passed on time.

M12 due in December: Selection of materials for main test series of HPFRCC.

Passed on time.

5. DISSEMINATION AND EXPLOITATION

In its first year of active work project SAMARIS has only had limited results to disseminate and none to exploit. The homepage of the project give access to the general public to general information about the project and to approved project reports.

General presentations of the project

11 June 2003, Lausanne, meeting with SAMARIS Reference Group of End Users (cf. 6.2)

Project coordinator and scientific coordinators report having given brief presentations of the project in national meetings with road sector stakeholders.

Articles about the project in general

None

Presentations of specific results

Denarié E., Habel K., Brühwiler E., (2003), "*Structural behaviour of hybrid elements with Advanced Cementitious Materials (HPFRCC)"*, presented in june 2003 at the fourth International RILEM Workshop on High Performance Fibre Reinforced Cement Composites, HPFRCC-4, Ann Arbor, Michigan, USA.

Habel K., Denarié E., Brühwiler E., (2003), "*Comportement à la rupture d'éléments hybrides formés de BFUP et de béton armé*", presented at the "Quatrième édition des Journées scientifiques du Regroupement Francophone pour la Recherche et la Formation sur le Béton $(RF)^2B$", Sherbrooke, Québec, Canada 25-26 août 2003, and published in the proceedings.

Articles about specific results

Denarié E., Habel K., Brühwiler E., (2003), "*Structural behaviour of hybrid elements with Advanced Cementitious Materials (HPFRCC)"*, in Proceedings of fourth International RILEM Workshop on High Performance Fibre Reinforced Cement Composites, HPFRCC-4, Ann Arbor, Michigan, USA, Edited by A.E. Naaman and H.W. Reinhardt, RILEM PRO 30, pp 301-312.

Habel K., (2003), "*Structural Behaviour of Hybrid UHPFRC-Concrete Elements* ", laboratory report MCS 99.04, MCS-EPFL, Switzerland

Other dissemination efforts

An 8-page colour brochure with a general presentation of the project, its objectives, organisation and consortium was produced and made available for circulation in September 2003.

6. MANAGEMENT AND COORDINATION ASPECTS

6.1 Contractors' committee

All 23 contractors are represented on the Contractors' Committee, which was established at the project kick-off meeting in Paris on the 22nd and 23rd of January 2003. The committee is convened every 6 months or as deemed necessary by the project coordinator, who calls and chairs the meetings. The tasks of this committee and the rules by which the committee operates are set out in section 6.1 of the Inception Report.

The committee held 2 meetings in 2003, the "founding" meeting in Paris as mentioned above, and 5 months later, on the 11th of June an ordinary meeting was held at the Swiss Federal Institute of Technology in Lausanne, where most contractors were gathered also for work package meetings and for the first meeting of the Reference Group of End Users. This meeting was attended by 13 contractors.

At the meetings the committee has been briefed about the overall situation and progress of the project and the coordinator has been updated on any changes to the organisation and key persons of the contractors. The meetings have also proven very useful as a forum in which the formal responsibilities and duties of contractors have been explained, interpreted and emphasized. This is a constant effort since many contractors have never before worked under the detailed regulations for participants in the Framework Programmes, while others, who have done it, may not have noticed the changes from earlier programmes.

An important issue for the Contractors' Committee in 2003 was the negotiation of a "Consortium agreement" on confidentiality and protection of pre-existing know-how and knowledge of Laboratoire Central des Ponts et Chaussées (LCPC) on a specific product to be used in the project. This agreement has relevance for the research undertaken in work package 14, High Performance Fibre Reinforced Cementitious Composites, which is front line applied research aiming at making the use of these novel materials possible for the maintenance of highway structures. The full agreement was signed by all contractors, including the contractors who are only active in the pavement stream of research, because under the contract with the Commission any contractor has the right to exploit the results collectively achieved by the project. By the agreement this right is waived by all members of the contractors' consortium.

The agreement is reproduced in its entirety at annex V.

Towards the end of 2003 a similar situation arose, when Sika Ireland Ltd. requested protection of information about the method of analysis of a corrosion inhibitor product, which they contributed to the research in work package 13, Corrosion Inhibitors. The negotiation of this agreement was still on-going by the end of the year, but had to be completed early in 2004 in order not to delay the project plan for WP13.

6.2 Management group

The Management Group consists of the project coordinator (chair) assisted by the project secretary, the two scientific coordinators and all work package leaders. This group has the operational leadership of the project and is the forum where the progress and problems of the scientific work packages are presented and discussed, deliverables approved and milestone passages confirmed. Thus this body maintains an up-to-date picture of the situation and is therefore also the body which can take intervention initiatives and – if necessary take decisions on major interventions to the Contractors' Committee.

The management group is also responsible for the compilation and drafting of the periodic reports to the Commission. Two such reports were drafted in 2003: The Inception Report (delivered 30 June) and the Management Report (delivered 31 August).

A project brochure for distribution at professional events or by project members to relevant members and visitors of their organizations was planned and produced in August-September and used for distribution since October 2003.

The group had four ordinary meetings in 2003, including the first meeting which took place in Paris. Other meetings were held in Madrid in April 2003, in Lausanne in June 2003 and again in Paris in October 2003. The summary records of these meetings are available on the SAMARIS web site.

6.3 Reference Group of End Users

Because the aim of the project is to influence the operational practices of road maintenance (an to some extent also road construction) and see new techniques and materials applied as soon as possible after project completion then end users become a very important target group.

Such a group was established in 2003, it numbers some16 individuals with relevant key functions in road administrations and industry.

This group was invited to meet with the project at the occasion in June 2003 when the preparation of the inception report was in its final stages. The group was briefed extensively about the plans and objectives of the project followed by an in-depth discussion of the needs and priorities of the end users on the issues addressed by the project.

The discussion highlighted the context in which the end users saw the project:

- It emphasised the importance of presenting the results so as to match the success criteria of those end users in road administrations who are directly responsible for the choice of strategies and techniques for maintenance and construction.
- Cost saving is the driving factor for implementing new techniques, but may be influenced very differently by national pricing schemes for waste disposal. Also, national principles, including rates of discount, for cost-benefit analyses differ considerably and may result in different implementation levels for the expected results of the project.

- Some concern was expressed about the image (and the quality of the output) of the road sector, if it was opened up too much to the use of recycled and secondary materials. The project should aim for high standards for such materials.
- The importance of co-ordinating closely with CEN was emphasised and the group was assured that the project had very close links to the relevant CEN working groups through double memberships, including CEN group chairmanships, of several project members.
- The probability of success or failure of structure repairs should be considered, at least qualitatively, and the repair strategy for structures should integrate all types of repair, not only the new high-tech methods.
- The end users encouraged the project to continue to seek more members for the reference group, including representatives from environmental authorities and perhaps the consulting engineering industry.
- The group was informed about the project's internet web pages and it was agreed that they should be advised by e-mail, whenever new results are accessible, which are considered relevant for them.
- Finally, it was agreed that the project could seek the assistance of the reference group for the validation reviews in the document QA process, i.e. end users will undertake to evaluate the validity of reports as sources of new information to be considered for practical use in the road sector.

The project did not seek new members for the reference group during the rest of 2003. The reason is that all road infrastructures related FP projects are seeking reference group members from the same rather limited selection of key persons in administrations and industry associations. This results in a counterproductive overloading of these persons with information and contacts, and the project coordinators are seeking a common solution to the problem.

As suggested in the discussions the reference group has been involved in the quality assurance process for project deliverables by having one of its members validating a project report. This was demanded for only one deliverable in 2003, but the intention is to apply this practice throughout the project when validation is required.

6.4 Clustering activities

Looking at potential synergies between SAMARIS and other on-going research project is also a concern of the management team.

Clustering of the pavement stream of research

For the pavement stream, clustering was especially envisaged with FORMAT, which is another project from the EU's 5th Framework Programme that has focus on road maintenance planning and started in the beginning of 2002. FORMAT especially aims at defining the most efficient techniques of road maintenance with high performance/cost ratio, considering not only direct costs due to works, but also indirect cost, such as those due to traffic delays.

In concertation with the FORMAT consortium, it was concluded that there were two main potential subjects of interest for SAMARIS. One is the selection of the repair techniques to be studied in depth by FORMAT, considering that some of them would rely on the use of material re-cycling; the other one is the outcome of the full scale experimentations to be

undertaken by FORMAT, especially the one programmed on the LCPC fatigue test track, concerning asphalt pavements. This information will be very valuable in SAMARIS for tasks 4.1, 5.1 and WP6.

Reciprocally from SAMARIS's work plan the main interesting outputs for FORMAT are the results expected from WP6's survey of the recycling by-products used in Europe for road construction or maintenance and the results expected from WP5 about the detailed database of full-scale experimentation and the modelling of rutting.

Besides, it was decided that mutual invitations would be sent at the occasion of the major meetings of FORMAT and SAMARIS, in order to exchange information on the on-going work and progress realised in each project. Such an event was the Lausanne meeting of SAMARIS' reference group, when Jean-Claude Turtschy from LAVOC was invited to present the main guidelines of FORMAT.

In 2003, the "Inception reports" were exchanged between the two projects, and SAMARIS received from FORMAT the survey report (D3) on the selection of maintenance techniques. This document shows, however, that the candidates selected as the most promising materials to be tested with full scale accelerated loading facilities do not rely on the use of re-cycled materials. Indeed the three types of solutions retained in FORMAT for testing are:

i) "cement mortar grouted porous asphalt",

ii) "high modulus asphalt + thin asphalt wearing course" against rutting

iii) "bituminous overlay with geotextiles or samis", against cracking in semi-flexible pavements.

Hence the interests of SAMARIS and especially of WP5 in the full scale experiments to be performed in FORMAT will not be as important as initially expected.

At the end of 2003 the new EU and FEHRL STREP project "NR2C" (New Road Construction Concepts) coordinated by LCPC was launched within the frame of the 6th Framework Programme. It presents some new clustering potentials vis-à-vis SAMARIS. These perspectives are mostly on the side of the structure stream (see further). However, for the pavement stream, one planned action in NR2C is to work on an innovative in-situ recycling technique, which in real time will identify the materials to be removed (unbound materials, bituminous mixes, cemented materials) and consequently adapt the re-cycling process, that is the addition and treatment of granulates, binder, cement. This could give rise to some exchange of information with SAMARIS and especially with WP6.

Clustering of the Structures stream of research

Clustering opportunities for the structures stream were in the year 2003 rather limited. However, two new 6th FW programme projects started recently and possible clustering activities will be investigated.

The first one is entitled "Sustainable bridges: Assessment for future traffic demands and longer lives" (www.sustainablebridges.net) and is coordinated by SKANSKA and the Lulea University of Technology, both from Sweden. However, it deals with railway bridges only, which makes it complementary to SAMARIS.

NR2C on "New Road Construction Concepts" will among other issues work on innovations in civil engineering structures. The objectives in the area of structures are to contribute to the

long-term vision of the road by providing a state of the art of both today's and tomorrow's innovations in the field of civil engineering structures and to develop specific innovations that concern highly-durable and maintenance-free structures. This research will focus on bridges since bridges account for a large majority of civil engineering structures. There are obvious opportunities for clustering with SAMARIS WP14 .

Of course, the FEHRL Road Research meeting scheduled in June 2004 will contribute to clustering activities by offering presentations and discussion opportunities of – among others - FORMAT, NR2C and SAMARIS.

6.5 Internet home page

SAMARIS Internet home page has been setup as the first deliverable of the SAMARIS project (D1) two months after the starting of the project. Pages were developed and are maintained in the MS Front Page and are available on the ZAG's server at http://samaris.zag.si/. They are divided into the public and private parts. The private part is further split into the 'Pavements' and 'Structures' stream pages. Public pages contain the following information:

- news about the project,
- description of objectives,
- general and detailed information about all partners,
- public documents available to all visitors of the pages,
- searching tool for theses documents,
- links to other documents relevant to the project,

The private pages contain restricted information available to the project partners and, to a limited extent, to the end-users, such as:

- information about meetings, organised by Work packages,
- QA status of the main deliverables,
- working and other documents relevant only to the project partners,
- searching tool for these documents.

All documents except the approved deliverables are protected by a password.

As number of documents started to grow, the SAMARIS document database (SDD) was developed. SSD is an application written in the PHP scripting language for dynamic HTML presentations and has the following features:

1. It assigns different privileges to the users based on their username and password. Users are divided into power users, normal users, end-users, guests and the administrator:
    - *Power users* are all Work Package leaders. They are allowed to add and upload new documents to all sections of the database. They can also change the QA (Quality Assurance) parameters and the 'Status' property of a document from 'Working', which can appear in as many versions as necessary, into 'Final'. Power users can download all documents available in the database.

- *Normal users* are only allowed to upload new versions of documents that already exist in the database into certain sections of the database.
- *End-users* can see and download only the final versions of some documents (excluding for example, minutes or other documents related to Management group, Contractors committee or Working group meetings). They can however obtain other internal technical documents that are otherwise available only to the project partners.
- *Guests* are all other visitors of the SAMARIS pages. They are only allowed to download final versions of the official deliverables of the project, when they are available, and some specific files prepared for the wide audience.
- *Administrator* has direct access to the database and can correct and even delete the entries. This may be required by the power users as a result of incorrectly input data, if number of versions of a file is excessively long or if total size of files approaches limits of the server's disk allocated to SAMARIS (2 GB). The administrator also sets the user names, passwords and priorities of the users.

2. It filters the documents using one or both of the following parameters:
   - Part of the project, which can be the *Management Group, Contractors committee, individual work packages*, etc. This allows different groups of partners to easily identify related documents.
   - Type of the document, which *can* be *Project Deliverable, Agenda, Minutes, Progress report, Cost statement, Other document* etc.
3. Assigns a unique number of the document based on rules agreed in the document on SAMARIS Document Numbering. This ensures that each document gets a unique name and is easily traceable. It also keeps track on the latest version of the existing documents and sets the correct version of the newly loaded files.
4. Keeps the QA status of the final deliverables by providing information about individuals who reviewed, verified and validated the documents and when this was done.

Over 1300 people visited the SAMARIS page in the first 9 months of its availability.

7. ECONOMY

7.1 Summary of costs by contractors

The table in Annex III presents the costs by category and by contractors, and it shows the total budgets of the contractors so as to allow comparison. The costs are transferred from the first year's cost statements by the contractors that have been submitted separately via the project coordinator to the Commission.

The tabulation in Annex III reveals no obvious problems in the first year's expenditure neither in the totals, nor in the individual cost categories. The consumption seems to be in keeping with the proportion of the work, which would have to be completed during the first year.

The coordinator and the project secretary has enjoyed good contacts with contractors. After the first half year all contractors were asked to submit cost statements to the Project Coordinator so as to "try" the forms and the principles before the first submission to the Commission. In many cases this uncovered mistakes and uncertainty with respect to the intended use of the forms, which were corrected. Thus, the annual costs statements are - by the coordinator's judgement - largely without any formal errors.

7.2 Summary of costs by work packages

The table in Annex IV presents the total expenditure on each work package, and the shares of these totals by each participating contractor. While the sum total of this table is correct and identical to the sum total of costs by contractors in Annex III, the expenditure of the individual contractor in the work packages and the total expenditure of the work packages are only estimates. The reason for this is that many contractors who participate in several work packages have not registered their costs at work package level. The coordinator has therefore asked them to give an approximate percentage distribution of their costs by work packages. This is the basis for the tabulations in Annex IV.

It is clear that a further breakdown of costs to the task level in this situation is meaningless, although many contractors could actually do it. The Management Group is aware that the information now available for overall management and control of the economy is less than perfect, and that it will prove insufficient in a situation where cost overruns make management interventions necessary. The issue will be subject to discussion at the next Management Group meeting in Dublin, and it is the intention to find a solution to the problem that will satisfy the needs of the management and is practicable for the contractors.

Work package leaders have not had any reports by contractors about cost overruns in work done up to now and have not observed any signs of it, so the project coordinator concludes that the cost and budget situation is satisfactory.

8. THE WAY AHEAD

8.1 Meetings

The schedule for the Management Group, the Contractors' Committee and the Reference Group meetings to be held until mid 2005 has been set up during the Bochum meeting. It is as follows:

2 April 2004	MG meeting at UCD in Dublin, Ireland.
15-17 June 2004	MG meeting CC meeting and reference group meetings to be held in conjunction with FEHRL Road Research Meeting in Bruxelles.
5-6 July 2004	Project Mid-term Evaluation in Nottingham, UK, with the attendance of all MG members.
8 October 2004	MG meeting at ZAG in Ljubljana, Slovenia.
20-21 January 2005	MG meeting, CC meeting and WP meetings at TRL in Crowthorne, U.K.
8 April 2005	MG meeting at LCPC, Nantes, France
13-16 June 2005	MG meeting, CC meeting and WP meetings expected to be held in conjunction with FEHRL Road Research Meeting in Bruxelles.

8.2 Pavement stream research

The WP teams are confident in the good continuation and progress of the work which has been initialised in 2003 and see no major difficulties to reach the 2004 objectives.

As the project goes on and reaches more detailed insights, special attention will have to be given to the coordination of the work and documents to be produced in the different WP, where needed (that is especially between WP3, WP4 and WP6), in order to anticipate the consolidation of the whole task at the end of the project. In particular, from an operational point of view, it could also be envisaged to gather and present some of the information and findings from SAMARIS under the form of a leaflet addressing each of the most important classes of re-used materials contemplated in the project.

With more detail and coming back to some of the information already given, the situation for the coming months is as follows.

- WP3 on *Assessment of Materials* will
  - Finalise the analysis of European and international document relating to re-use of materials as the basis for deliverable D9;

- Continue and complete work on task 3.2, Definition of the assessment methodology, including the important milestone M7;
- Complete all its planned work with the issue of deliverable D16, Report on the methodology for assessing the possibility to re-use alternative materials.

- WP4 on *Safety and Environmental Concerns in Materials specifications* will
  - Continue working on the main theme of "Detection of Hazardous Components in Materials to be recycled" following the delayed issue in March 2004 of the report (D7) on "Existing test method for detection of hazardous materials";
  - The very limited responses to the questionnaire on "Road authorities positions to reaction to fire of pavement materials" will be documented and constitutes the basis for determining the need for a test procedure for reaction to fire of pavements materials (M13), which is the possible continuation of this task.
  - In august work will be intitiated on the last task of this WP: an approach to "Environmental Annexes to Products Standards"
- WP5 on *Performance Based Specifications* will
  - Work on the database of relevant field trials and accelerated loading tests continues according to plans and a report is due at the end of March;
  - Continue selection, calibration and testing of models to predict permanent deformation of pavements of granulated unbound materials including additional testing as deemed necessary at milestone M14 after submission of D10, which reports on existing models and demonstrated validity;
  - Continue selection, calibration and testing of models to predict rutting of pavements of bituminous bound materials including additional testing as deemed necessary at milestone M15 after submission of D11, which reports on existing models and demonstrated validity.
- WP 6 on *Techniques for Recycling* will
  - Finalise work on recommendations for mixing plants for recycling with the issue of D12 scheduled for June, which is one intermediate result in the continued of work towards the final "Technical Guide on Techniques of Recycling" ;
  - Complete analysis of responses to questionnaire on the situation in CE countries as regards recycling and issue the result in D15, due in August 2004.

8.3 Structures stream research

In year 2004 the work in the Structures stream will be as follows:

- WP12 on *Strategies for rehabilitation of highway structures* will work on development of guidelines, particularly on collection examples of case studies and information on how decisions are currently taken in European countries
- WP13 on *Corrosion Inhibitors* will work on:
  - investigation of corrosion behaviour in concrete and mortar specimens,

- major testing programme, including expediting the major field trial in the United Kingdom and possibly in Slovenia or Ireland and continuation of the field exposure trial on laboratory-cast specimens,
- report on test of effectiveness of corrosion inhibitors in laboratory trials (D17 in month 24)

- WP14 on *HPFRCC* will work on:
  - updating of the State of the Art Report on HPFRCC with the latest developments to produce deliverable D13 at the end of month 18,
  - tasks 14.2 *Interpretation – modelling* and 14.3: *Numerical parameter study* which will start in months 13 and 22 resp.
  - report on preliminary studies for the use of HPFRCC for rehabilitation of road infrastructure components (D13 in month 18) and on tests of HPFRCC in the laboratory (D18 in month 24)
- WP15 on *Survey* will work on:
  - assessment of questionnaires received from selected countries and State-of-the-art report of assessment of structures in selected countries (D19 in month 24)
  - development of the Handbook of damages, traffic load modelling, long-term experiment to asses realistic dynamic loading due to heavy vehicles

8.4 Deliverables

Annex VI contains the revised list of deliverables and milestones from which it can be seen that 2004 will be a very productive year as regards deliverables.

Nine from the pavement research stream:

WP 6	Literature survey of recycling of by-products in road construction in Europe
WP 5	Data base and report on reference full-scale tests results on pavements
WP 4	Review of road authorities' positions on reaction to fire of pavement materials
WP 3	Critical analysis of European documents
WP 5	Report on models for prediction of permanent deformation of unbound materials in flexible pavements
WP 5	Report on models for prediction of rutting of bituminous surface layers
WP 6	Recommendations for mixing plants for recycling works
WP 6	Situation in the CE countries as regard recycling
WP 3	Report on methodology for assessing the possibility to re-use materials for road construction

And four from the structure research stream:

WP 14	Report on preliminary studies for the use of HPFRCC for rehabilitation of road infrastructure components
WP 13	Report on test of effectiveness of corrosion inhibitors in laboratory trials
WP 14	Report on tests of HPFRCC in the laboratory
WP 15	Report on state-of-the-art of the assessment of structures in selected EEA and CE countries

In addition, a mid-term report is due prior to the mid-term evaluation in July 2004

8.5 Newsletters and other dissemination efforts

WP 16 on Dissemination and Exploitation is preparing the plan for the presentation of SAMARIS at the European Road Research Meeting, organised by FEHRL, in Bruxelles in June 2004.

Also, as results of relevance to end users and other researchers are starting to come out, this work package will issue short newsletters, whenever such results have accumulated in sufficient amounts to offer interesting reading opportunities.

ANNEXES

I. **Glossary of terms**
II. **List of contractors**
III. **Summary of costs by contractors**
IV. **Summary of costs by work packages**
V. **Consortium Agreement on Confidentiality and Protection of Pre-existing Know-how**
and Knowledge of LCPC on Specific Products
VI. **Revised Classification and Overview of Deliverables, Milestones and Due Months**

ANNEX I:

Glossary of Terms

ALT-MAT	4th FW project on ALTernative MATerials in Road Construction
BRIME	4th FW project on Bridge Management in Europe
BWIM	Bridge-WIM system using existing bridges for weighing heavy vehicles
CEC	Central European countries
CEN	European Committee for Standardization
CI	Corrosion inhibitor - Chemical component that slows down corrosion or eliminates corrosion process
COST	European Cooperation in the filed of Scientific and Technical Research
COURAGE	4th FW project on COnstruction with Unbound Road AGgregates in Europe
EC	European Commission
ECC	Engineered Cementitious Composites
EEA	European Economic Area
EU	European Union
FHWA	Federal Highway Administration
FORMAT	5th FW project on Fully Optimised Road Maintenance
FRC	Fibre Reinforced Concrete
HPFRCC	High Performance Fibre Reinforced Cementitious Composites
NORECON	Nordic network for repair and maintenance of concrete structures
NR2C	6th FW project on New Road Construction Concepts
OECD	Organisation for Economic Co-operation and Development
PHP	scripting language for dynamic HTML presentations
PIARC	World Road Association
POLMIT	4th FW project on Pollution of Groundwater and Soil by Road and Traffic Sources
REHABCON	EU Project on strategies for maintenance and rehabilitation in concrete structures
RETRAEST	Transport R&D Co-operation with Central and Eastern European Countries
RILEM	International Union of Laboratories and Experts in Construction Materials, Systems and Structures
SDD	SAMARIS document database
UHPFRC	Ultra High Performance Fibre Reinforced Composites

WIM	weigh-in-motion, techniques for weigh of heavy vehicle under normal traffic

ANNEX II

List of Contractors

SAMARIS List of Authorized persons and contact persons						
Nr.	Abbreviation	Country	Contractor	Authorized persons	Contact person	Tel, fax and e-mail of contact person(s)
1	DRI	DK	Danish Road Institute Elisagårdsvej 5 DK 4000 Roskilde	Jørgen Christensen	Jørgen Christensen	Tel: +45 46 30 71 07 Fax. +45 46 30 71 05 ris@vd.dk
2	LCPC	F	LCPC 58, Bld. Lefebvre F - 75732 Cedex 15	1. Jacques Roudier 2. Robert Baroux	Jean-Michel Piau	Tel. + 33 2 40 84 58 28 Fax. +33 2 40 84 59 94 Jean-Michel.piau@lcpc.fr
3	ZAG	SL	ZAG - Slovenian National Building and Civil Engineering Institute Dimiceva 12 SI-1000 Ljubljana, Slovenia	Prof. Dr. Miha Tomazevic	Ales Znidaric	Tel. +386 1 280 42 07 Fax. +386 1 280 44 84 ales.znidaric@zag.si
4	TRL	UK	TRL Old wokingham Road RG45 6AU Berkshire UK - Crowthorne	Mike Head	Cliff Nicholls	Tel. +44 0 1 344 770 276 Fax. +44 0 1 344 770 686 cnicholls@trl.co.uk
5	UCD	IE	University College Dublin Belfield Dublin 4 Republic of Ireland	1. Donal Doolan 2. Susan Hedigan	Mark Richardson Ciaran McNally	Tel. +353 1 716 7241 Fax. +353 1 716 7399 mark.richardson@ucd.ie ciaran.mcnally@ucd.ie
6	CEDEX	E	Centro de Estudios de Carreteras CEDEX Alfonso XII, 3 E - 28014 Madrid	Manuel L Martin	Francisco Sinis	Tel. +34 1 335.78.12 Fax. +34 1 335 78.22 francisco.sinis@cedex.es
7	EPFL	CH	ISS-DGC/EPFL-Ecublens Ecole Polytechnique Fédérale CH - 1015 Lausanne - Suisse	Eugen Bruehwiler	Emmanuel Denarié	Tel. 00 41 21 693 2893 Fax. 00 41 21 693 5885 emmanuel.denarie@epfl.ch
8	ISTU	AT	Institute for Road Construction & Maintenance, Technical University,Vienna Gusshausstrasse 28/233 A - 1040 Vienna, Austria	Wolfgang Oberndorfer	Ronald Blab Johann Litzka	Tel. +43 1 58801 233 00 Fax. +43 1 58801 233 99 rblab@istu.tuwien.ac.at jlitzka@istu.tuwien.ac.at

SAMARIS List of Authorized persons and contact persons						
Nr.	Abbrev iation	Coun-try	Contractor	Authorized persons	Contact person	Tel, fax and e-mail of contact person(s)
9	SHELL	F	Shell Global Solutions B.P. 97 Route Départementale 3 F - 76650 Petit-Couronne	Johannes van der Werff	Richard Koole	Tel. +332 32 66 63 01 Fax. +33 2 32 66 64 70 richard.koole@shell.com
10	TCD	IE	Civil Structural & Environmental Engineering Trinity College (University of Dublin) College Green, Dublin 2 , Ireland	John Hegarty	Alan O'Connor	Tel. +353 1 608 18 22 Fax. +353 1 677 30 72 alan.oconnor@tcd.ie
11	UPC	E	Universitat Politéchnica de Catalunya Jordi Girona, 1-3 Modul C1, Campus Nord E - 08034 Barcelona	Josep Ferrer	Joan Ramon Casas	Tel. +34 93 401 71 26 Fax. +34 93 401 71 30 joan.ramon.casas@upc.es
12	IST	PT	Technical University of Lisbon/IST Av. Rovisco Pais 1 1049-001 Lisboa Portugal	Matos Ferreira	Antonio.Correia	Tel. +351 2535 102 00 Fax: +351 2535 102 17 agc@civil.uminho.pt
13	VTI	SE	Swedish National Road and Transport Research Institute, VTI Olaus Magnus Vaeg 37 S - 581 95 Linköping	Urban Karlström	Karl-Johan Loorents	Tel. +46 13 20 43 19 Fax. +46 13 141 436 karl-johan.loorents@vti.se
14	SIKA	IE	SIKA Ireland LTD Unit 3, Ballymun Industrial Estate Dublin 11, Ireland	Declan Carroll	Declan Carroll Pat Mulligan	Tel. +353 1 862 0709 Fax. +353 1 862 07 07 dcarroll@sika.ie mulligan.pat@ie.sika.com
15	DHI	DK	DHI Water and Environment Agern Alle 11 DK - 2970 Hørsholm	1. Joern Rasmussen 2. Karsten Krogh Andersen	Ole Hjelmar	Tel. +45 45 16 94 05 Fax. +45 45 16 92 92 oh@dhi.dk
16	ECN	NL	Netherlands Energy Research Foundation Business Unit ECN Clean Fossil fuels P.O.Box 1 Westerduinweg 3 NL - 1755 ZG Petten	1. Frans Willem Saris 2. Cornelis van der Klein	Hans van der Sloot	Tel. +31 224 56 42 49 Fax. +31 224 56 31 63 vandersloot@ecn.nl

SAMARIS List of Authorized persons and contact persons						
Nr.	Abbrev iation	Coun-try	Contractor	Authorized persons	Contact person	Tel, fax and e-mail of contact person(s)
17	ENTPE	F	FORMEQUIP. Ecole Nationale des Travaux Publics de L'Etat, ENTPE Rue Maurice Audin F - 695 18 VAULX-EN-VELIN	Yves Perrodin	Cecile Delolme	Tel. +33 4 72 04 70 42 Fax. +33 4 72 04 77 43 cecile.delolme@entpe.fr yves.perrodin@entpe.fr
18	UNH	US	University of New Hampshire, Office of Sponsored Research Service Building 51 College Road Durham, New Hampshire 03824-3585, USA	Kathryn Cataneo	Taylor Eighmy	Tel. +1 603 862 10 65 Fax. +1 603 862-3564 t.eighmy@rmrc.unh.edu
19	RUB	DE	Ruhr University Bochum Institute for Roads and Railways P.O.Box 102148 Universitaetsstrasse 150 D - 44801 Bochum	Elmar Vielhaber	Klaus Krass Sabine Schnell	Tel. +49 234 32-27437 Fax. +49 234 32 14152 klaus.krass@ruhr-uni-bochum.de sabine.schnell@ruhr-uni-bochum.de
20	RSG90	DK	RSG90 Selinevej 4 DK - 2300 Copenhagen S	Martin Juul	Karsten Ludvigsen	Tel. +45 32 4890 41 Fax. +45 32 50 80 80 kludvigsen@rgs90.dk
21	TuBrno	CZ	Vysoké Uceni Technicke Brno, TU Brno Road Department, Antoninska 1 60190 Brno, Czech Republic	1. Jan Vrbka 2. Jifi Kazelle	Jan Kudrna Michal Varaus	Tel. +420 5 411 47 357 Fax. +420 5 412 43 081 kudrna.j@fce.vutbr.cz varaus@sil.fce.vutbr.cz
22	IBDIM	PL	Road and Bridge Research Institute ul. Jagiellonska 80, PL 03-301 Warszawa	Leszek Rafalski	Dariusz Sybilski	Tel. +48 22 811 03 83 Fax. +48 22 811 17 92 sybilski@ibdim.edu.pl
23	EURO VIA	F	Eurovia Management Place de L' Europe No. 18 F - 92565 RUEIL MALMAISON	1.Michèle Cyna 2.Jean Pierre Marchand	Samir Soliman	Tel. +33 (0) 1 47 16 46 70 Fax. +33 (0) 1 47 49 19 70 ssoliman@eurovia.com technique@eurovia.com

ANNEX III

Summary of Costs by Contractors

Budget Follow-up Table

PARTNER	Cost Category	BUDGET (EUR)	ACTUAL COSTS (EUR)		Total Pct. Spent (%)	Remaining Budget (EUR)	*Comments on major deviations*
			Year 1	Total	Year 1		
		e	a1	e1	a1/e	e-e1	
1. DRI	Labour	160371	38283	38283	24%	122088	
	Overheads	128297	30626	30626	24%	97671	
	Labour+Overhd.	288668	68909	68909	24%	219759	
	Travel	22269	7863	7863	35%	14406	
	Durable Eqmt.						
	Consumables	30000				30000	
	External Assist.	97538	40214	40214	41%	57324	
	Other						
	..						
	Total	438475	116986	116986	27%	321489	
1. DRI -SEK	Labour	64682	21150	21150	33%	43532	
	Overheads	51746	16920	16920	33%	34826	
	Labour+Overhd.	116428	38070	38070	33%	78358	
	Travel	6777	2731	2731	40%	4046	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	123205	40801	40801	33%	82404	
2. LCPC	Labour	261756	53598	53598	20%	208158	
	Overheads	209393	42882	42882	20%	166511	
	Labour+Overhd.	471149	96480	96480	20%	374669	
	Travel	37759	8556	8556	23%	29203	
	Durable Eqmt.						
	Consumables	32344	7353	7353	23%	24991	
	External Assist.						
	Other						
	..						
	Total	541252	112389	112389	21%	428863	
3. ZAG	Labour	317618	92676	92676	29%	224942	
	Overheads	63523	18535	18535	29%	44988	
	Labour+Overhd.	381141	111211	111211	29%	269930	
	Travel	45506	12086	12086	27%	33420	
	Durable Eqmt.	5000				5000	
	Consumables	20000	2503	2503	13%	17497	
	External Assist.	38186	13764	13764	36%	24422	
	Other						
	..						
	Total	489833	139564	139564	28%	350269	

Budget Follow-up Table

PARTNER	Cost Category	BUDGET (EUR)	ACTUAL COSTS (EUR)		Total Pct. Spent (%)	Remaining Budget (EUR)	*Comments on major deviations*
			Year 1	Total	Year 1		
		e	a1	e1	a1/e	e-e1	
4. TRL	Labour	339833	110406	110406	32%	229427	
	Overheads	377317	115926	115926	31%	261391	
	Labour+Overhd.s	717150	226332	226332	32%	490818	
	Travel	36791	2754	2754	7%	34037	
	Durable Eqmt.						
	Consumables	28000				28000	
	External Assist.	105320	5715	5715	5%	99605	
	Other						
	..						
	Total	887261	234801	234801	26%	652460	
5. UCD	Labour	171476	33174	33174	19%	138302	
	Overheads	44517	8016	8016	18%	36501	
	Labour+Overhd.s	215993	41190	41190	19%	174803	
	Travel	27110	5966	5966	22%	21144	
	Durable Eqmt.	6000				6000	
	Consumables	18000	940	940	5%	17060	
	External Assist.						
	Other						
	..						
	Total	267103	48096	48096	18%	219007	
6. CEDEX	Labour	82760	25696	25696	31%	57064	
	Overheads	66208	20563	20563	31%	45645	
	Labour+Overhd.s	148968	46259	46259	31%	102709	
	Travel	11619	3749	3749	32%	7870	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	160587	50008	50008	31%	110579	
7. EPFL	Labour	288459	91894	91894	32%	196565	
	Overheads	12074	2274	2274	19%	9800	
	Labour+Overhd.s	300533	94168	94168	31%	206365	
	Travel	20000	7315	7315	37%	12685	
	Durable Eqmt.	40000				40000	
	Consumables	34000	6530	6530	19%	27470	
	External Assist.	37576	5248	5248	14%	32328	
	Other	20000	3234	3234	16%	16766	
	..						
	Total	452109	116495	116495	26%	335614	

Budget Follow-up Table

PARTNER	Cost Category	BUDGET (EUR)	ACTUAL COSTS (EUR)		Total Pct. Spent (%)	Remaining Budget (EUR)	*Comments on major deviations*
			Year 1	Total	Year 1		
		e	a1	e1	a1/e	e-e1	
8. ISTU	Labour	51606	9835	9835	19%	41771	
	Overheads	11367	2570	2570	23%	8797	
University OH 20 % on everything	**Labour+Overhd.s**	62973	12405	12405	20%	50568	
	Travel	5228	3013	3013	58%	2215	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	OH 20% all costs						
	Total	68201	15418	15418	23%	52783	
9. SHELL	Labour	89434	25232	25232	28%	64202	
	Overheads	22363	2986	2986	13%	19377	
	Labour+Overhd.s	111797	28218	28218	25%	83579	
	Travel	10639	412	412	4%	10227	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	122436	28630	28630	23%	93806	
10. TCD	Labour	35106	14021	14021	40%	21085	
	Overheads	9345	3281	3281	35%	6064	
University OH 20 % on everythig	**Labour+Overhd.s**	44451	17302	17302	39%	27149	
	Travel	11619	3460	3460	30%	8159	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	OH 20% of all						
	Total	56070	20762	20762	37%	35308	
11. UPC	Labour	24373	9196	9196	38%	15177	
	Overheads	19498	7356	7356	38%	12142	
	Labour+Overhd.s	43871	16552	16552	38%	27319	
	Travel	11836	916	916	8%	10920	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	55707	17468	17468	31%	38239	

Budget Follow-up Table

PARTNER	Cost Category	BUDGET (EUR)	ACTUAL COSTS (EUR)		Total Pct. Spent (%)	Remaining Budget (EUR)	*Comments on major deviations*
			Year 1	Total	Year 1		
		e	a1	e1	a1/e	e-e1	
12. IST	Labour	20909	3253	3253	16%	17656	
	Overheads	26569	3145	3145	12%	23424	
	Labour+Overhd.s	47478	6398	6398	13%	41080	
	Travel	4841	1918	1918	40%	2923	
	Durable Eqmt.						
	Consumables	1112				1112	
	External Assist.						
	Other						
	..						
	Total	53431	8316	8316	16%	45115	
13. VTI	Labour	35695	11929	11929	33%	23766	
	Overheads	38306	12778	12778	33%	25528	
	Labour+Overhd.s	74001	24707	24707	33%	49294	
	Travel	5809	8595	8595	148%	-2786	
	Durable Eqmt.						
	Consumables						
	External Assist.	13974	1298	1298	9%	12676	
	Other						
	..						
	Total	93784	34600	34600	37%	59184	
14. SIKA	Labour	22738	2800	2800	12%	19938	
	Overheads	7958	980	980	12%	6978	
	Labour+Overhd.s	30696	3780	3780	12%	26916	
	Travel	5809	1090	1090	19%	4719	
	Durable Eqmt.						
	Consumables	10000				10000	
	External Assist.						
	Other						
	..						
	Total	46505	4870	4870	10%	41635	
15. DHI	Labour	36540	6977	6977	19%	29563	
	Overheads	36180	6767	6767	19%	29413	
	Labour+Overhd.s	72720	13744	13744	19%	58976	
	Travel	5809	3328	3328	57%	2481	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other	5800				5800	
	computing		766	766		-766	
	Total	84329	17838	17838	21%	66491	

Budget Follow-up Table							
PARTNER	**Cost Category**	**BUDGET (EUR)**	**ACTUAL COSTS (EUR)**		**Total Pct. Spent (%)**	**Remaining Budget (EUR)**	***Comments on major deviations***
			Year 1	**Total**	**Year 1**		
		e	a1	e1	a1/e	e-e1	
16. ECN	Labour	72137	23052	23052	32%	49085	
	Overheads	41734	16242	16242	39%	25492	
	Labour+Overhd.s	113871	39294	39294	35%	74577	
	Travel	4306	3601	3601	84%	705	
	Durable Eqmt.						
	Consumables	3000	1220	1220	41%	1780	
	External Assist.						
	Other						
	..						
	Total	121177	44115	44115	36%	77062	
17. ENTPE	Labour	33716	14396	14396	43%	19320	
	Overheads	7905	3320	3320	42%	4585	
	Labour+Overhd.s	41621	17716	17716	43%	23905	
	Travel	5809	2206	2206	38%	3603	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	47430	19922	19922	42%	27508	
18. UNH	Labour	100000	77210	77210	77%	22790	
	Overheads						
	Labour+Overhd.s	100000	77210	77210	77%	22790	
	Travel	11100	1600	1600	14%	9500	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	111100	78810	78810	71%	32290	
19. RUB	Labour	48130	2059	2059	4%	46071	
	Overheads	10401	751	751	7%	9650	
University 20% on everything	**Labour+Overhd.s**	58531	2810	2810	5%	55721	
	Travel	3873	1697	1697	44%	2176	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	62404	4507	4507	7%	57897	

Budget Follow-up Table

PARTNER	Cost Category	BUDGET (EUR)	ACTUAL COSTS (EUR)		Total Pct. Spent (%)	Remaining Budget (EUR)	*Comments on major deviations*
			Year 1	Total	Year 1		
		e	a1	e1	a1/e	e-e1	
20. RSG90	Labour	49592	7221	7221	15%	42371	
	Overheads	39674	5777	5777	15%	33897	
	Labour+Overhd.s	89266	12998	12998	15%	76268	
	Travel	3873	2388	2388	62%	1485	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	93139	15386	15386	17%	77753	
21. TuBRNO	Labour	33333	16984	16984	51%	16349	
	Overheads	26666	13587	13587	51%	13079	
	Labour+Overhd.s	59999	30571	30571	51%	29428	
	Travel	5809	2077	2077	36%	3732	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	65808	32648	32648	50%	33160	
22. IBDIM	Labour	76312	30742	30742	40%	45570	
	Overheads	15262	6148	6148	40%	9114	
	Labour+Overhd.s	91574	36890	36890	40%	54684	
	Travel	19751	5637	5637	29%	14114	
	Durable Eqmt.						
	Consumables						
	External Assist.		1165	1165		-1165	
	Other						
	..						
	Total	111325	43692	43692	39%	67633	
23. EUROVIA	Labour	41640	10082	10082	24%	31558	
	Overheads	66623	16132	16132	24%	50491	
	Labour+Overhd.s	108263	26214	26214	24%	82049	
	Travel	11619	3382	3382	29%	8237	
	Durable Eqmt.						
	Consumables						
	External Assist.						
	Other						
	..						
	Total	119882	29596	29596	25%	90286	

Budget Follow-up Table							
PARTNER	**Cost Category**	**BUDGET (EUR)**	**ACTUAL COSTS (EUR)**		**Total Pct. Spent (%)**	**Remaining Budget (EUR)**	***Comments on major deviations***
			Year 1	**Total**	**Year 1**		
		e	a1	e1	a1/e	e-e1	
TOTAL	Labour	2458216	731866	731866	30%	1726350	
	Overheads	1332926	357562	357562	27%	975364	
	Labour+Overhd.s	3791142	1089428	1089428	29%	2701714	
	Travel	335561	96340	96340	29%	239221	
	Durable Eqmt.	51000				51000	
	Consumables	176456	18546	18546	11%	157910	
	External Assist.	292594	67404	67404	23%	225190	
	Other	25800	3234	3234	13%	22566	
	Computing		766	766		-766	
	Total	4672553	1275718	1275718	27%	3396835	

ANNEX IV

Summary of Costs by Work Packages

SAMARIS : WP costs Table					
		Work on WP Kilo euro			
WP	**Partner**	**Year 1**	**Year 2**	**Year 3**	**Total**
WP 1: Management	DRI	28,351			
Jørgen Christensen	ZAG	16,608			
	Total	44,959			
WP 2: Review, development	LCPC	12,100			
of pavement programme	TRL	7,044			
Jean-Michel Piau	CEDEX	1,000			
	DRI	4,320			
	Total	24,465			
WP 3: Assessment of	LCPC	48,100			
materials	CEDEX	2,000			
Denis Francois	DRI	42,280			
	VTI	34,600			
	DHI	17,838			
	ECN	44,115			
	ENTPE	19,922			
	TuBrno	3,265			
	UNH	78,810			
	Total	290,930			
WP 4: Safety and	TRL	28,176			
Cliff Nicholls	LCPC	5,100			
	SHELL	14,315			
	RUB	4,507			
	Total	52,098			

SAMARIS : WP costs Table					
		Work on WP Kilo euro			
WP	**Partner**	**Year 1**	**Year 2**	**Year 3**	**Total**
WP 5: Performance-based specifications **Erik Nielsen**	DRI LCPC ISTU SHELL TRL IST	38,884 24,089 15,418 14,315 2,348 8,316			
	Total	103,370			
WP 6: Techniques for recycling **Francisco Sinis**	CEDEX RSG90 TuBrno IBDIM EUROVIA	45,507 15,387 29,383 24,642 29,596			
	Total	144,516			
WP 12: Inception report for Structures Programme **Richard Woodward**	TRL ZAG UCD EPFL	98,617 12,003 11,650			
	Total	122,269			
WP 13: Corrosion Inhibitors **Mark Richardson**	UCD ZAG SIKA TRL	14,429 44,660 4,870 58,701			
	Total	122,659			

SAMARIS : WP costs Table					
		Work on WP Kilo euro			
WP	**Partner**	**Year 1**	**Year 2**	**Year 3**	**Total**
WP 14: HPFRCC materials	EPFL	104,846			
Emmanuel Denarié	TRL	39,916			
	LCPC	20,000			
	Total	164,762			
WP 15: Survey of highvay	ZAG	52,755			
structures	IBDIM	19,050			
Ales Znidaric	TCD	20,762			
	UPC	17,468			
	UCD	33,667			
	EPFL				
	Total	143,702			
WP16: Exploitation	ZAG	13,538			
Jørgen Christensen	LCPC	3,000			
	DRI	3,150			
	CEDEX	1,500			
	Total	21,188			
Total all WPs		1,234,918			
Administration DRI-sekr.		40,801			
Total work		**1,275,719**			

ANNEX V

Consortium agreement on confidentiality and protection of pre-existing know-how and knowledge of LCPC on specific product.

EU project SAMARIS

Consortium agreement on confidentiality and protection of pre-existing know-how and knowledge of Laboratoire Central des Ponts et Chaussées (LCPC)

on a specific product to be used in the project

1. In the framework of project SAMARIS ("the Project") LCPC shall supply, free of charge and solely to EPFL-MCS, the entire recipe (matrix and fibres) of the product called $CEMTEC_{multiscale}$®. LCPC grants to EPFL-MCS a royalty-free license for the use of such recipe for carrying out the Project. The said product is covered by the French patent applications #FR2806403 and #FR2806404 (both published on 9th September 2001) and by the PCT patent application WO0168548 (published on 9th September 2001)

2. Among the data of the recipe of $CEMTEC_{multiscale}$® only the following element shall not be disclosed neither orally nor in writing in any kind of publication or report: exact composition of the fibrous reinforcement (individual volumetric percentages and types of each fibre used).

3. No access rights for exploitation shall be granted to the partners of the Project, neither during the Project nor after its completion, on the composition of the fibrous reinforcement of the product $CEMTEC_{multiscale}$® as such composition is defined in the patent applications mentioned above.

4. Any information other than the ones defined in Section 2 above, obtained in the framework of the Project, including the results of the tests on the material $CEMTEC_{multiscale}$® either in the fresh or hardened state, alone or in combination with concrete in hybrid elements, may be disclosed and published according to the rules set forth in the Contract with the Commission.

5. This agreement is approved and signed by all contractors and assistant contractors in the Project.

Date:

For contractor/assistant

contractor:Name (block letters):

Signature:

ANNEX VI

Revised Classification and Overview of Deliverables, Milestones and Due Months

Revised classification and overview of deliverables, milestones and due months according to Inception report

Background

This document contains a revised classification of all contracted deliverables in project SAMARIS. It serves the purpose of facilitating the Commission's prioritization of the review and approval processes for these deliverables.

Primary deliverables

Table 1 lists the 9 deliverables which are considered as primary in the sense that they shall bring out those final results which represent the achievement of the objectives of the project. They will all be verified by independent researchers and validated by representative end users before being approved by the project management committee and submitted to the Commission.

Other deliverables

Table 2 lists all other deliverables and identify the primary deliverable to which they are affiliated. Many of them will present results and conclusions of original experimental research and will as such need verification by independent researchers before management committee approval and submission. Others are state-of-the-art reports that may be based on literature surveys or on international information collection by questionnaires. They will in most cases need independent evaluation in the form of verification or validation before approval and submission. The process will be decided on a case-by-case basis. This table also contains all deliverables from the management and the dissemination activities of the project.

Milestones

Table 3 lists all milestones in the project.

Guide to the tables

The rows of the tables are shaded to distinguish between deliverables from

- the pavement stream of work packages, with light grey background
- the structures stream of work packages, with dark grey background, and
- the management and dissemination work packages, with unshaded background

The detailed planning of work that preceded the writing of the Inception Report revealed a few cases of problems that required the rescheduling of the due dates of deliverables and associated milestones. This is presented in the "Delivery Month" column and the necessary explanations are in all cases given in the footnotes.

Table 1: Overview of the primary deliverables			
Deliverable No.	**Delivery date (month)**	**Output from WP**	**Nature of deliverable and brief description**
D15	20	6	Situation in the CE countries as regard recycling
D16	24 (+2)[1]	3	Report on methodology for assessing the possibility to re-use materials for road construction
D22	30	14	Report on tests of HPFRCC in the field
D24	31	4	Environmental annexes to road products standards
D25	33	13	Specifications for the use of corrosion inhibitors for maintenance of highway structures
D27/D28	33	5	Calibration and validation report for modelling of permanent deformation of unbound and bituminous layers in flexible pavements and recommendations for the definition of performance-based specifications
D29	33	6	Technical guide for recycling techniques in road construction
D30	33	15	Guidelines for optimised assessment of highway structures
D31	36	12	Guidelines on selection and use of innovative materials for the rehabilitation of highway structures

[1] As originally foreseen in Table 9 of "Description of Work". Erroneously listed in Table 5.1 of same document as month 22.

Table 1: Overview of other deliverables and project outputs				
Deliverable No.	**Delivery date (month)**	**Output from WP**	**Nature of deliverable and brief description**	**Integrated in primary deliverable no.**
D1	3	16	Project web-site	n.a.
D2	6	2 and 12	Developed work programme/Inception report	n.a.
D3	7	16	Brochure presenting the project	n.a.
D7	10	4	State of the art report on test methods for the detection of hazardous components in road materials to be recycled	D24
D4	12 (+5)[2]	3	State of the art report "Existing specific national regulations applied to material recycling"	D16
D5	15 (+3)[3]	6	Literature survey of recycling of by-products in road construction in Europe	D15
D6	15 (+3)[4]	5	Data base and report on reference full-scale tests results on pavements	D27/D28
D8	14	4	Review of road authorities' positions on reaction to fire of pavement materials	D24
D9	15	3	Critical analysis of European documents	D16
D10	15	5	Report on models for prediction of permanent deformation of unbound materials in flexible pavements	D27/28
D11	15	5	Report on models for prediction of rutting of bituminous surface layers	D27/28
D12	18	6	Recommendations for mixing plants for recycling works	D29
D13	18	14	Report on preliminary studies for the use of HPFRCC for rehabilitation of road infrastructure components	D31
D14	18	1	Mid-term assessment report	n.a.
D17	24	13	Report on test of effectiveness of corrosion inhibitors in laboratory trials	D31
D18	24	14	Report on tests of HPFRCC in the laboratory	D31
D19	24	15	Report on state-of-the-art of the assessment of structures in selected EEA and CE countries	D30

2 Originally foreseen in Table 9 of "Description of Work" to be due in month 9. Erroneously listed in Table 5.1 of same document as month 7. Will require international questionnaire and subsequent analysis. Rescheduled (from month 9) to month 12.

3 Rescheduled due to change of leader of Work Package 6.

4 Because of the synergy between the models and the data in the database, it is advantageous if the database and hence D6 coincide with the D10 and D11 due in Month 15. This change in an intermediate step in WP5 will not change the total duration of the WP.

D20	30	4	Report on test procedure for reaction to fire of pavement materials	D24
D21	30	13	Report on test of effectiveness of corrosion inhibitors in field trials	D31
D23	32	4	Report on test methods for the detection of hazardous components in road by-products	D24
D26	33	14	Modelling of HPFRCC in hybrid structures	D31
D32	36	16	Final executive summary report	n.a.
D33	36	16	Briefing material for national promotion of project results	n.a.
D34	38 (new)[5]	1	Summary technological implementation plan	n.a.

[5] This deliverable was not foreseen in Annex 1 "Description of work" of the contract.

Table 2: Overview of the Milestones				
Milestone No.	**Delivery date (month)**	**Output from WP No.**	**Brief description of Milestone objectives**	**Criteria for assessment**
M1	3	16	Project web-site	Fully operational home page with basic project information
M2	6	12	Complete review of repair methods for structures	Inception report for structure WPs available
M3	6	13	Decisions on properties of concretes to be used in laboratory and field test trials of CI.	Selection of materials
M4	6	14	Identification of most important phenomena for defining HPFRCC main test programme	Results of numerical simulations and preliminary tests available
M5	6	2	Approval of scientific methodology and work programme for pavement WPs	Consistency with objectives of project
M6	9	12	Complete critical review of relevant R&D work	Internal draft report available
M7	12	3	Determine the influent parameters and their range of variation before developing the methodology for assessing the possibility to use by-products	Suitability of the information collected
M8	12	4	Evaluation of existing test methods for detection of hazardous components and decision for the development of new tests	Applicability of existing methods to the context of recycling
M9	16 (+4)[6]	5	Evaluation of full-scale pavement tests results data base and need for additional specific data to be collected	Quality and completeness of data sets
M10	15 (+3)[7]	6	Approval of the draft of the structure and table of content of the technical guide on recycling techniques	Comparison with information collected from literature survey and enquiry.
M11	12	15	Collection of structural data completed	All questionnaires completed and returned
M12	12	14	Selection of materials for main test series of HPFRCC	Preliminary test results and conclusions concerning materials for main tests available
M13	15	4	Determine the necessity to develop test	From road authorities answers.

6 This milestone is dependent on D6 for which revised due month is explained in footnote 3 to table 2.

7 This milestone is dependent on D5 for which revised due month is explained in footnote 2 to table 2.

Table 2: Overview of the Milestones

Milestone No.	Delivery date (month)	Output from WP No.	Brief description of Milestone objectives	Criteria for assessment
			methods for assessing the reaction to fire of pavement materials.	
M14	16	5	Evaluation of the need for additional tests for validation of models for permanent deformation of unbound materials in flexible pavements	Comparison of existing data with model requirements
M15	16	5	Evaluation of the need for additional laboratory tests for validation of models for rutting of bituminous layers	Comparison of existing data with model requirements
M16	18	15	Collection of traffic data completed	Database on traffic data base and WIM measurements available
M17	19	1	Mid-term assessment passed	Consistency with work-programme and objectives of the project
M18	21(-3)[8]	14	Choice of on-site applications for pilot tests of HPFRCC	Results and interpretations of main test series available
M19	33	16	Final symposium organised	Preparations completed

[8] The laboratory tests will make this decision possible and desirable 3 months earlier than originally foreseen.