

# INNOVATION TO REDUCE THE ENVIRONMENTAL IMPACT OF ROAD WORKS SITES – THE PROPICE PROJECT

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## ABSTRACT

PROPICE (optimised preservation and rehabilitation of infrastructure assets subject to constraints induced by traffic, the environment and frontage residents) is a French research programme set up in 2006 and funded by the ANR (National Research Agency). The purpose of the project is to develop strategies for management of existing infrastructure assets (road in particular) and technological and methodological tools to contribute to material reduction of the nuisance induced by work sites on these infrastructures, as regarded from three essential viewpoints:

- nuisance induced for public travel and transport,
- nuisance to residents adjacent to work sites,
- more general environmental impact resulting from these work sites.

This research project is coordinated by the Egis Group, and involves leading national players (companies, an operator, a construction authority, research laboratories and a university).



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Photo 1 - The nuisance for users during the work is tangible.

## 1. CONTEXT OF THE PROPICE PROJECT

### 1.1. Research framework

The ANR (National Research Agency) public interest group set up early in 2005, has decided to implement a number of research and innovation programmes and actions in various domains, and has appointed ADEME (Agency for the Environment and Energy Management) as its backup establishment in connection with a number of these

programmes. The PROPICE project was selected following a nation-wide call for proposals.

The aim of this research project is to develop strategies for management of existing infrastructure assets (roads, airport runways, dedicate public transport way) and technological and methodological tools to contribute to a material reduction in the nuisance induced by work sites on these infrastructures, for public travel and transport, frontage residents and the immediate environment of the work site.

## 1.2. Duration and parties

The project is planned to last 36 months (2006 to 2008).

This is a special, innovative project insofar as it associates professional entities and operating methods which are habitually different. The programme covers all phases of a design project preceding the operational phase.

The Egis Group is acting as coordinator of the PROPICE programme.

The consortium comprises:

- research entities: CSTB (Building Industry Scientific and Technical Centre), LCPC (Central Road Construction and Maintenance Laboratory) and LGC/CF (Clermont-Ferrand University Civil Engineering Laboratory);
- infrastructure construction companies: Bouygues Travaux Publics and Colas;
- an infrastructure construction and operating authority: ASF (Autoroutes du Sud de la France);
- an infrastructure designer: Egis Group (with three of its subsidiaries: Scetauroute, Isis and Infraplan).

## 2. 2. PROJECT ORGANISATION

### 2.1. Subdivision by task

The project has been subdivided into five major tasks each with its specific output. The following table describes the five tasks. These are explained in detail in sections 2 to 6.

Table 1 : Tasks presentation

| Task | Description                          | Objective   | Output  |
|------|--------------------------------------|---|---|
| 1    | Assistance with selection of options | Definition and assessment of issues and strategies  | Optimal maintenance, strategies and facilities for maximum reduction of nuisance to users   |
| 2    | Design                               | Transposition of optimised methods from new projects  | Space-time optimisation methodologies for development and heavy maintenance   |
| 3    | Execution                            | Study of technical and organisation-related solutions, to enhance management of work sites, minimise their impact and increase asset durability | Recommendations for work site management to reduce nuisance, optimise costs and increase durability between successive maintenance operations |
| 4    | Operation                            | Guaranteed traffic fluidity, minimised risks for users,   | Recommendations (new procedures) for works  |

|   |                      |   |   |
|---|----------------------|---|---|
|   |                      | and work site and operating personnel   | programming and traffic management, with test work reports  |
| 5 | Knowledge management | Application of comprehensive knowledge management and concurrent engineering methods, to contribute to innovation and develop performance | Transverse tools contributing to upstream and downstream innovation and discreet work performance |

Egis coordinates all the above tasks (see Figure 1).

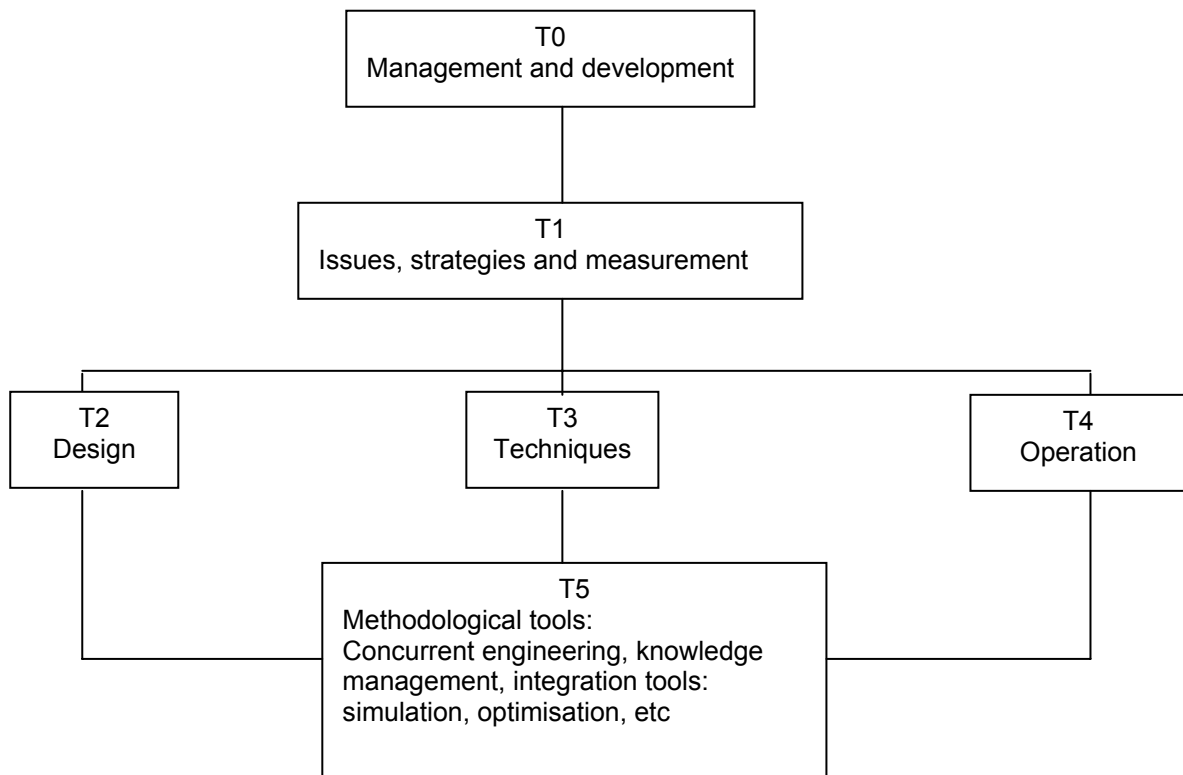


Figure 1: Project management structure

## 2.2. Upstream performance

The objective is to assist the construction authorities to establish, at the upstream stage, durable asset management strategies that fully integrate customary costs. This task is highly interactive with the other tasks aimed more at the upstream phases of projects. One of the major issues of the PROPICE programme is to identify solutions that take account of rehabilitation project cycles, from the (political) decision to go ahead with the project through to its implementation.

This global objective combines a number of sub-objectives:

- definition and establishment of nuisance typology,
- design of a nuisance management solution measurement tool,

- proposals for operational methodological tools designed to minimise nuisance at the early stages,
- development of dialogue and communication tools for decision-makers,
- estimation of financial impacts.



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Photo 2 – Paris « Marechaux » ring tramway construction shows the importance and difficulty of controlling public traffic (vehicles and pedestrians).

### 2.3. Design

Principally designed to meet the needs of the construction authority, this task is also highly interactive with the needs of the builder and operator. It concerns the design of rehabilitation, improvement and maintenance work on the asset: its purpose is to transpose optimisation methods developed in the design of new projects by multi-skill engineering. Innovative design of a development project can indeed require the development of dedicated work site techniques calling for application of special operating measures.

A number of points must be addressed:

- identification of different methodologies for organisation of work and operation in a work site context, based on the experience of the construction authorities,
- definition of methods for optimising the space-time combination on linear work sites,
- application of value analysis to the specific characteristics of discreet work sites,
- identification of critical tasks for discreet work sites and corresponding good practice based on case studies,
- research and development in road maintenance techniques and the design of rehabilitation projects for major engineering structures.



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Photo 3 – Works on motorways : variable message signs for motorist information

#### 2.4. Work site techniques and organisation

This task responds principally to the needs of the contractor. It concentrates on the "works" phase of the life cycle of a structure, in the context of the "discreet work site" approach. Its objective is to study technical and organisation-related solutions leading to both:

- enhanced work site management from the point of view of global cost, duration of the work, flexibility, work site dimension, resources and equipment employed, and the reactivity reserve in regard to unpredictable events,
- minimisation of work site impact on the user, frontage residents and the environment,
- increased durability and interval between two successive infrastructure maintenance operations.

This task concerns two types of work, each with its specific characteristics. These are road works and civil engineering work.

The task is broken down into four sub-tasks:

- ✓ constraints associated due to the presence of the works site,
- ✓ global cost,
- ✓ reduced work site noise,
- ✓ knowledge of new products.



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Photo 4 - The safety of users and personnel must be guaranteed.

## 2.5. Operation in a work site context

The objective is to ensure traffic flow under optimum conditions of safety and fluidity when a work site is in operation. This task principally meets the requirements of the operator, and its aim is to minimise interference with traffic flow for users, but also the risks to which they are subject (pedestrians, cyclists, motorcyclists and car-drivers) as also work site and operating personnel.

An analysis of the existing situation has been conducted in regard to optimisation aid tools for dealing with user nuisance during the work site programming phase with the members of the consortium (ASF and Egis). Interviews were conducted with the majority of concession companies, to establish their practices and needs in the areas of work programming and operation during construction.

## 2.6. Knowledge management

The objective is to contribute to an efficient interaction between parties, and the sharing of knowledge through the contribution of information and communication technologies. This task is aimed at applying the most comprehensive knowledge management possible. It will also be necessary to develop concurrent engineering methods to contribute to innovation, and in particular the design of "discreet work sites", which are not only discreet but rapid in their execution. The aim here is to optimise design and management of complex work sites where heavy traffic conditions are encountered, from the point of view of the municipality. Various actions have been defined for the implementation of this task:

- identification of information and communication technologies which can assist the execution of discreet work sites throughout the duration of road infrastructure projects,
- identification of technical and organisation-related conditions and their application, taking due account of existing practices and tools,
- specification of the architecture for a software environment making it possible to achieve more efficient cooperation between players during the various phases concerned,
- specification and modelling of a knowledge-sharing tool for the members of the consortium, and an experience capitalisation tool.

This task is transverse by nature, and closely associated with the other tasks.



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Photo 5 - The information of users is essential

### 3. ANTICIPATED RESULTS

#### 3.1. An innovative research method

Concurrent engineering is in its element in this project, while the approach is global from one end (preliminary study by the construction authority) to the other (operating phase measures).

Within this consortium context, information which is fragmented and dispersed between the various players can be cross-related, opening up paths and identifying new ways of working together.

The desire to adopt a common, efficient language between the widely differing players, and to share knowledge, is a very powerful aspect of this project.

The first major step has been to capitalise experience acquired by the members of the consortium to avoid any dispersion of ideas. A joint maintenance guide has been prepared for this purpose as part of task 1.

Work sites representing both types of work in a work site context (urban environment and motorways in open country) have also been analysed. Two work sites have been examined particularly closely (Paris: tramway work site on the "boulevards des maréchaux" and roofing in of the "périphérique" ring motorway at the Porte des Lilas). Interviews were held with the various players (construction financing authority, contractor, construction authority, etc.) on the same work site.

"Those who know" were also interviewed to obtain details of their experiences and their views on these problems.

Assessment of these interviews identified work vectors or areas requiring examination in greater depth for 2007. A number of key points emerged:

- work charter with the network concession companies,
- time scale relating to all work site resource-related constraints,
- efficient communication campaign,
- thoughts on the structure for calls for tenders,
- collation of good practices regarding the safety of workers,
- energy budget for work site operations.

A joint methodology guide will be published on completion of the project, and intensive communication is being conducted throughout the project.

A number of output documents are drafted throughout the project, and several have already been issued, including a nuisance typology plan produced very early on. The plan is evolutive and is being enriched as the research project progresses.

Consultation of the various operators has enabled us to define requirements concerning a work site nuisance optimisation aid tool. Certain aspects have emerged:

- optimisation of work characteristics according to estimated nuisance level,
- identification of optimum timing for execution of each phase of the work,
- information on forecast nuisance generated by each work phase.

In particular, an experimental work site will provide the opportunity to apply recommended methods in 2008.

### 3.2. Growth market

This market is very substantial given the upsurge in urban development and the average age of the infrastructures. In France at the present time, work site operation under traffic conditions in the urban environment represents a market exceeding 1 billion euros per year, for an existing capital amount of about 100 billion euros. For the French inter-urban concession motorway sector, rehabilitation of certain segments will cost up to 40% of the cost new.

Social repercussions can be very substantial:

- early rehabilitation before the point of total impossibility is reached (as in certain foreign countries),
- development of a durable asset management strategy,
- reduction of CO2 under congested traffic conditions, noise, security, etc.,
- 10 to 20% reduction in user nuisance by comparison with current practices. The order of magnitude of the socio-economic value of reduced user nuisance appears to equate to around 1 billion euros per decade,
- avoidance of very serious traffic congestion resulting from a single road accident at a work site subject to very high traffic throughput.



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Photo 6 - The task is to minimise risks for work site and operating personnel



#### 4. CONCLUSION

This research project responds to a strong social demand for "minimised nuisance", while ensuring durable management of the asset represented by the major road infrastructures. It responds indeed to very substantial and intensifying issues resulting from the increasing age of the infrastructures, relating to safety, financial aspect, the environment and the economy.

To avoid the unfortunate experiences encountered in other countries, resulting from rehabilitation work undertaken too late, it is essential to develop durable asset and nuisance reduction management strategies, so that maintenance and rehabilitation work is accepted by frontage residents and road users, and conducted in due time.

The approach adopted for this purpose is highly pragmatic: analysis of the good practices adopted for recent projects by interviewing the corresponding authorities, followed by the most rigorous possible quantification of nuisances to identify corresponding solutions ; finally drafting of a methodology guide to assist future players to prepare a logical approach which is continuous from one end to the other of an infrastructure development project conducted under traffic conditions (choice of options, design, execution and operation).

The combination of skills and experiences as diverse as those of the various members of this consortium (research, design, execution and operating entities) should make it possible to achieve this aim.

To attempt to take up these challenges at a professional level and in a consortium context truly makes sense. It has been decided to go ahead on a partnership and collective basis to "innovate and disenclave" more efficiently the conventional areas of activity of each player on this highly complex subject, while respecting and indeed ameliorating the experience of each party.

But if we are to succeed, we must not lose sight of the other players, those on whom the projects are imposed, namely the users of the road infrastructures and the frontage residents. In this respect, communication campaigns at each stage of the project represent a key component of success. The road user, like the frontage resident, will accept the nuisance generated by this type of work site more readily if they have been fully informed on its execution (phasing, global duration, etc.), and the improvement of their respective situations which they will ultimately enjoy.

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