# COMMISSION OF THE EUROPEAN COMMUNITIES

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COMMUNICATION FROM THE COMMISSION TO THE COUNCIL AND THE EUROPEAN PARLIAMENT

concerning

**R&D in Dedicated Road Infrastructure for Vehicle Safety in Europe**

## (DRIVE)

*- Progress Report '89 and Mid-Term Review -*

(presented by the Commission pursuant to Articles 6/3 and 9 of the Council Decision 88/416/EEC of 29/06/88 on the Programme DRIVE)

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ANNEXES

*Executive Summary*

*Demand for Road Transport in Europe is continuously increasing. The integration of the internal market is giving it a considerable additional boost. However, this is associated with an increased number of problems: on average 55,000 people have been killed, 1,700,000 injured and 150,000 permanently handicapped each year during the 1980's as a result of road accidents. The financial costs of these accidents is estimated at 50 billion ECU per year. In addition, the costs of operating vehicles in the Community, including the time spent, fuel and the increase in noise and air pollution, through traffic congestion and poor routing adds up to another 500 billion ECU each year.*

*European cooperation aiming at the improvement of road safety and traffic control was given a considerable boost with the adoption in June 1988 of the DRIVE (1) Programme for a period of three years commencing the 1st of June 1988.*

*The three main objectives of the DRIVE Programme are to :*
- *improve road safety*
- *increase the efficiency of road transport and,*
- *reduce the environmental damage and pollution caused by road traffic.*

*These objectives will be achieved by the application of the most advanced information and communication technologies both to the roadside infrastructure and to road vehicles. DRIVE helps to answer the question "How can we best exploit the new information technologies within the field of road transport, by supporting pre-competitive research and development in this area".*
*The ultimate goal of the programme is the creation of a coherent approach to a future integrated road transport environment.*
*The decision proposed a review after 18 months. This communication includes a report or the implementation of the programme, the results of the 18 month reviews and the investigation of future requirements and options.*
*Sixty research projects, set up under the DRIVE Programme, started their work in early 1989 whilst another twelve in mid'89.*
*Those projects were selected out of a total of some 220 proposals submitted to the EC Commission in response to a public call for proposals. Each project is a consortium of companies and institutions from various European countries. Each project is made up of organisations from more than one country.*
*Work under the DRIVE programme brings some 1,000 researchers and technical specialists from 300 different organisations together. Projects are planned to run for between 12 and 36 months. Their total financial value is around 120 million ECU of which 50 % is financed by the European Community, 50 % by the project partners. Participants from EFTA countries are also involved in an important number of projects without, however, receiving EC financial support.*
*DRIVE projects bring together all the major actors concerned with road safety and traffic control issues in Europe: vehicle manufacturers, the information and communication industries, operators of telecommunication networks, specialised research institutes, automobile associations, ministries and other public bodies. They have demonstrated the willingness and ability to collaborate in this domain.*
*The results described in this document are based on the outcome of several audits of the DRIVE programme conducted by independent experts.*
*The outlook to future collaborative work in this domain is based on the work of a Requirements Board and of Technical Panels which were conveyed in the framework of the investigation of future requirements and options in the field of Advanced Road Transport Telematics*

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(1) DRIVE = Dedicated Road Infrastructure for Vehicle for safety in Europe

## 1. The Introduction

The transport sector is, and will continue to be, a very important part of the European economy. It represents more than 6% of GNP and more than 10% of the average family budget is devoted to transport. Road Transport represents between 80 and 85 % of the total passenger/km carried out in Europe. Furthermore, car ownership has steadily increased over the last decade. Although there are now some 120 million motor cars in Europe, the rate of car ownership still lags substantially behind that of the U.S. (330 versus 550 cars per 1,000 inhabitants), indicating that further growth can be expected. Already the negative impacts of road transport on both human safety and the environment are significant:

- Every year in the Community around **55,000 people are killed** on the roads, **1.7 million are injured** and **150,000 permanently handicapped**. The financial cost of this is estimated to be more than 50 billion ECU per year; the social cost in human misery and suffering cannot be measured.

- The total cost of operating vehicles in the Community, including time spent driving which for an average European represents 2.5 years of his life, is estimated to be 500 **billion** ECU per year. There is an enormous potential for savings simply through improved routing and congestion reduction.

- Vehicle emissions are a significant element of total environmental pollution. Emissions are estimated to cost Europe between 5 and 10 billion ECU per year.

Current trends indicate an average growth rate in demand for road travel in excess of 3% per year which, if continued, implies a 50% increase in traffic between now and the end of the century. Demand for international road travel is increasing at double that rate. The Community's aim of achieving the Internal Market by 1992 is giving extra impetus to the forces creating demand.

Existing approaches such as traffic management schemes, civil engineering improvement, engine management technology and Community directives on vehicle standards are important but do have their limitations.

Innovations and cost reductions in information technology, telecommunications and broadcasting offer new opportunities for effective solutions to many of these problems. Integrated to provide advanced communications, control and information systems they enable not only new, more flexible and responsive forms of traffic management but also supply road users with improved means for trip planning, modal choice, route guidance, vehicle fleet utilization and increased safety.

This report addresses the context, organisation and results of the Programme in Section 2.
The context, organisation and results of the audits of the Programme are described in Section 3.
Conclusions regarding the future strategic direction are developed in the light of the results of the audits and the views of a panel of experts which considered the future development for the Programme in Section 4.

The DRIVE audits have three distinct components :

- **A Requirements and Strategic Audit,** which evaluates the performance of DRIVE as a whole with respect to the strategic and policy objectives of the Community in an international context and future developments,
- **A Technical Audit,** which evaluates the performance of the DRIVE projects with respect to the DRIVE objectives,
- **A Programme Management Audit,** which evaluates the performance of the Commission in its responsibility for the management of the Programme.

The detailed conclusions of the audits are described in the appendices to this document.
Further appendices summarise the work of DRIVE and list the participating organisations. A list of references, glossaries and an index are also provided.

## 2. The context and approach of DRIVE

### 2.1. Meeting the challenge of Road Transport Informatics (RTI)

The DRIVE programme addresses the challenge of exploiting the developments of Information technology and telecommunications (IT + T) in the field of Road Transport. It takes into account both the transport policy and telecommunications policy of the EC, linked to the standardisation policy and the information market policy, it builds on related work in the Community's Research Framework programme but also to Eureka projects in this domain.
DRIVE through pre-competitive and collaborative R & D in the field of Information Technology and telecommunications applied to Road Transport and in synergy with developments in the field of the automobile, seeks to create favourable conditions for the development of the "Integrated Road Transport Environment" in Europe.
In this way it is oriented towards meeting the requirements fo the internal market, international competitiveness and the need to contribute to the socio-economic advancement of the Community.

### 2.2. The objectives of DRIVE

The global objective of DRIVE is through R + D on Road Transport Informatics to
*"allow a break through in road safety, a major improvement in road transport efficiency and a significant reduction in pollution"*.
Given this general theme, the Council expressed its concern that DRIVE should also have the following goals :

1. Contribute to the creation of an Integrated Road Transport Environment.
2. Identify the best choice of systems and the best strategy for implementation.
3. Produce guidelines to which industrial products and European regional infrastructure should conform.
4. Develop performance specifications and standards in order to enable industry to develop the necessary components.
5. Implement pilot schemes.

How these objectives are adressed and what impact can be expected by the on going projects is described in the table below.

Review of the "General Objectives"stated in the Decision of the Council

| General Objectives | Ways in which these objectives are addressed | Global Impact expected from DRIVE work |
|---|---|---|
| *Use of the Road Transport informatics technologies for achieving breakthrough in road safety* | Development of Road Accident data recording systems and new techniques for their analysis | Specifications of in-vehicle accident data recording and roadside policing equipment. Formulation of advanced system for accident data analysis. |
| | Evaluating behavioural and technological aspects | Methodology of behaviour monitoring of drivers and elderly persons and the effects of RTI on behaviour |
| | Developing systems for vulnerable road users | New techniques applied in traffic lights at heavily pedestrianised areas |
| | Examining appropriate man/machine interfaces and collision avoidance system specifications | Specifications for in-car co-driver type assistance and anticollision system |
| | Addressing impact and implementation questions | Development of a road safety management expert system, standards for the in-car man-machine interface, recommendations for minimum safety standards for design of equipment for RTI systems |
| *Achieve a major improvement in road transport efficiency* | Modelling and developing systems for transport demand control | System architecture for demand-management systems and development of new planning tools incorporating the advances possible using RTI systems. Improved parking management and control. New simulation tools for impact of RTI on traffic flows |
| | Developing systems for interurban traffic control | Recommendations for dynamic traffic messages and tidal flow and control systems; architecture for tunnel control systems; development of dynamic algorithms for effective use of origin-destination information. |
| | Developing systems for urban traffic control (UTC) | Specifications for system design and algorithms integrating Route Guidance to UTC. Realisation of a real time urban traffic control system, including new strategies to prevent congestion |
| | Developing incident detection systems, including the use of Artificial Intelligence | Prototype AI system for urban traffic control including computer vision for incident detection, and incorporation of techniques to assess road and weather conditions and detect incidents and congestion automatically. |
| | Developing on-line and off-line public transport management systems | Recommendations and specifications for a computer-aided scheduling, operation, information and control system for public transport |
| | Developing Freight Management systems | Definition of strategy and organisational structure for international road freight operation. |
| | Developing appropriate data bases | Development of a prototype navigation database, including a European digital road map and standards for road database management. |
| | Developing information and broadcasting systems | Recommendations for traffic data transmission systems and driver information |
| | Assessing appropriate communication technologies systems and architecture | Evaluation of different communication techniques for traffic control, vehicle location, road pricing and data acquisition. |
| *Achieve significant reduction in pollution* | Developing appropriate tools for modelling environmental effects and integrating these on traffic control strategies | Development of models confirmed by field trials into noise and pollution effects with and without RTI systems. New techniques accomodating the effects of RTI improvement on the environment, in traffic control. |

| General Objectives | Ways in which these objectives are addressed | Global Impact expected from DRIVE work |
|---|---|---|
| *Contribute to the creation of an integrated road transport environment (IRTE)* | By defining the functional requirements and specifications of the IRTE and recommending international standards<br>By achieving concensus between all sector actors on the specifications and implementation plans | Functional requirements and recommendations for standardisation for IRTE<br><br>Development of a concise framework for continuous and regular exchange of views of different sector actors. |
| *Identify the best choice of systems and the best strategy for implementation* | Development of appropriate tools for techno-economic evaluation<br>Assessment of Telecommunications Technologies<br><br>System Engineering and Concensus Formation activities | Evaluation framework and structure to ensure that assessment and analysis is fairly made using identical assumptions and criteria.<br>Identification of appropriate telecommunication means for addressing various applications.<br>Creation of a dedicated team to ensure the activities are cross-related and new developments are shared within DRIVE. |
| *Produce guidelines to which industrial projects and European Regional Infrastructure should conform* | Collaboration of industrial actors and European authorities responsible for telecom and road infrastructures within the projects. Develop concensus on the guidelines of services applications. | Standardisation of systems under development within DRIVE to ensure smooth integration and minimum waste of research capabilities |
| *Develop performance specifications and standards for industrial production* | By projects addressing standards and specifications in the areas of traffic control, traffic safety, services, telecommunications and databases. | Developing prenormative technological work preparing Europe's standardisation proposals. Rationalisation of the work on the main technology options. Closer collaboration from all sector actors preparing for the specifications. |
| *Implement pilot schemes* | Develop guidelines for field trials and run prototype tests on public transport, freight transport, trip planning and traffic control projects. | Production of comprehensive manual for field trial methods and criteria. |

## 2.3 The scope and status of the work of the DRIVE programme

In order to meet DRIVE's objectives a detailed Workplan[2] was prepared by the Commission, with the participation of all sector actors, and was adopted by the DRIVE Management Committee (which consists of representatives from all the Member States). The DRIVE Workplan defines exactly the scope and content of the programme in a series of Tasks. It has been used as the basis for the public Call for Proposals from which all current DRIVE projects originated.

### *2.3.1 Overview of the Workplan*

DRIVE's Workplan comprises six Chapters and 119 specific tasks. Chapter 0 relates to the management functions of the DRIVE Central Office. Chapters 3 & 4 are the core R&D activities. Chapter 3 is concerned with the functional analysis development and evaluation of road transport management systems. Chapter 4 does the same for road safety systems. Chapters 1, 2 and 5 of the Workplan are complementary 'horizontal' activities. Chapter 1 is concerned with overall Programme coherence, Chapter 2 with evaluation criteria and tools, Chapter 5 with issues associated with an eventual Europe-wide implementation of RTI.

In brief, the chapters in the Workplan are:

Chapter 0: Management Tasks (6 tasks)

relating to the overall management of the Programme including information exchange and project control. Also concerned with the external environment through consensus formation with the actors and with promoting acceptance of European RTI standards. These were not included in the Call for proposals.

Chapter 1: The Systems Approach (33 tasks)

relating to the strategic direction of the entire research Programme; ensuring a "top-down" approach accompanied by iteration with the projects carried out under the other Chapters to secure adjustments to preliminary definitions of system scope and feasibility.

Chapter 2: Evaluation (13 tasks)

to develop tools and criteria against which to evaluate the results of the research done under the Programme; to support this with modelling of various "base" road traffic system characteristics against which scenarios of changed behaviour arising from the use of RTI systems and services can be assessed; to perform evaluations of results; to use these assessments to make recommendations for standards, for common systems, for implementations, for demonstrations and for further research.

Chapter 3: Road Transport Management Systems (33 tasks)

relating to the development of functional specifications and system design for RTI-based road transport management taking into account existing developments and the aim of realising system integration.

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(2) DRIVE Workplan : ref DRI 100, 26 April 1988

Chapter 4: Road Safety System (17 tasks)

relating to the investigation of the new safety systems and services offered by the use of RTI; to the definition of functional specifications and system designs and standards for them; taking into account the need to provide improvements for all road users. Relating also to the definition of safety performance specifications for all new RTI systems and their testing.

Chapter 5: Implementation Aspects (16 tasks)

relating to the standardisation, economic and financial, legislative and regulatory, and social issues affecting implementation of RTI systems and services.
Within two Calls for proposals, all work defined by the Decision of DRIVE has been taken up within the resources given to the programme.

*2.3.2 Relation between the Workplan and Annex I of the Council Decision*

The Workplan represents the 3 parts of the Council decision as follows:
- Chapters 3 and 4 and part of 1 of the Workplan are the core R&D activities. They correspond largely to Part I of Annex I of the Decision.
- Chapters 1, 2 and 5 are complementary "horizontal activities". They correspond largely to Part II of Annex I of the Decision.
- All specifications standards-related work present in Chapters 1, 3, 4 and 5 of the Workplan feature in Part III of Annex I of the Decision.

SUMMARY OF THE USE OF RESOURCES IN THE DRIVE PROGRAMME

| | Decision | | Shift of Workplan |
|---|---|---|---|
| | MECU | % | % |
| PART I: RTI technologies | 32.9 | 60 | -2 |
| PART II: Evaluation of strategic options | 12.0 | 22 | +1 |
| PART III: Specifications, protocols and standardisation proposals | 9.9 | 18 | - |

2.4 The first results of the DRIVE programme

The DRIVE programme will result in significant advances in the European Road Transport and telematics environment. In particular, it will lead to the development of:

- Concerns on the priority choices between technological options for implementation.
- Technology based on the outcome of mainly theorectical and some experimental investigation of technical problems.
- User interaction at an early stage in the planning of the next generation of systems in Europe.

These will lead to awareness creation in Europe and an early reaction of sector actors thus making a significant contribution to enabling the European Automobile, Transport and IT industry and services actors to obtain a strategic competitive advantage in the exploitation of the growing global market opportunities.

However, the work initiated under DRIVE is only the first, albeit essential, step towards improved communications and better integration in Road Transport in Europe. The next step should be to build on the current work in order to expand and consolidate the links which have been established between the Transport Community, Industry and research institutes.

The table below gives a global overview of DRIVE. More is given in the Annex and for the details reference is made to the technical report "DRIVE '89".

| General Description | Ways in which DRIVE approaches these aspects |
|---|---|
| Decision | 88/416/EEC of 29.06.88, OJ L206/p.1 of 30.07.88 |
| Title | Community Programme in the field of road transport informatics and telecommunications (DRIVE) |
| Duration | 01.06.88 to 01.06.91 |
| Community financial contribution | 60 MECU representing 50% of the overall effort estimated at 120 MECU |
| Financing of EFTA participants | The partners from EFTA countries do not receive funding from the Community but, inversely contribute to the management |
| Number of persons involved | 950 |
| Overall objective | Concerting European efforts in improving road transport efficiency, road safety and reduction of environmental impact. |
| Scope | Action Line I. Road transport informatics (RTI) technologies<br>Action Line II. Evaluation of strategic options<br>Action Line III. Specifications, protocols and standardisation proposals |
| Nature of the cooperation | Pre-competitive and Prenormative R&D cooperation |
| **Participation in DRIVE:** | **Is open to all organisations established in the Community and EFTA countries** |
| Road Transport service providers and users | 37 unique participations |
| University research establishments | 55 unique participations |
| Telecom and Informatics Industry | 42 unique participations |
| Road Transport Informatics industry | 18 unique participations |
| Automobile Industry | 15 unique participations |
| Other industry | 14 unique participations |
| Government or other research establisments | 49 unique participations |
| Telecom Administrations | 2 unique participations |
| Other | 27 unique participations |
| EFTA participation | 17 different organisations with 36 participations from Finland, Norway, Sweden and Austria as full and equal partner |
| Number of consortia | 73 |
| Number of organisations involved | 298 |
| Number of participations in projects | 480 |
| **DRIVE interworks with:** | **Other policies at Community and National level** |
| CEPT (RR1) | via Group mixed RACE set up by CEPT and informal contacts with RR1. |
| ETSI | Protocol which defines the interworking via the "Consensus Management Project" in RACE. In addition via a specific working group to be established to deal with infrastructure-vehicle communications |
| EBU, CEN/CENELEC, and SPAG | Periodic consultation meetings and specific working group in CEN/CENELEC |
| EFTA national administrations | Periodic briefing and consultation sessions |
| ESA | via the coordination group set up by the Commission to coordinate telecommunications policy matters |
| COST | Periodic concertation meetings and direct links between related projects. Participation in the COST transport Technical Committee |
| ESPRIT | via Commission internal collaboration and via the respective Management Committees |
| ECMT | DRIVE participates in the Transport, Informatics and Telecommunications Committee |
| Infrastructure Committee (CEC, DG VII) | Periodic Concertation meetings |
| Telecommunications Policy | via the Senior Officials Group Telecommunications (SOG-T) and collaboration with COM DG XIII/D |
| Standardisation Policy | via COM DG XIII/E and SOG-ITS |
| Transport Policy | via COM DG VII/B and infrastructure Committee DG VII/C, and ECMT |

Review Summary Table DRIVE Programme

| DRIVE Management: | Follows initial practice |
|---|---|
| Programme Management | Responsibility of the Commission supported by DRIVE Management Committee. Advises the Commission on the implementation in general, adopts the yearly Workplan, assessment of proposed projects, level of Community finance, participation of EFTA organisations, exceptions from the general rules |
| Project Management | Responsibility of the Project Consortia |
| **DRIVE Workplan:** | **Describes in the context of the objectives all work which is to be carried out under the programme** |
| Definition of the rationale and tasks | Developed with the sector actors concerned and formally adopted by Management Committee every year |
| Revision and update | The Workplan is revised every year in the light of the evolution of the objectives and the technology options |
| Impact Assessment and Forecasting | As a contribution to the yearly update of the Workplan and of the projects a systematic investigation of developments world-wide are undertaken. This is in addition to visits and contacts with related actions world-wide |
| International contacts | Contacts are maintained and by yearly visits reinforced |
| **Dissemination of DRIVE results:** | **Is built into the programme** |
| Programme-level | This is carried out via yearly progress reports to Council and Parliament as well as yearly "Technical Reports" |
| Project-level | Projects disseminate their own results in scientific fora. Deliverables from DRIVE projects are shared with related DRIVE projects and final results are mostly in the public domain. Standardisation-related results via the Systems Engineering and Consensus Formation Office (SECFO) project within the programme |
| Within the Programme | Every six weeks, Concertation meetings bring together all project leaders and some of their team members with the Commission to review progress and disseminate results |
| Within the Project Consortia | Regular project internal meetings assure transparency, coordination and dissemination of the results while the work is progressing |
| Quality Control | Project Officers assess the deliverables and follow the monthly management reports. Once a year independent external experts carry out a Technical Audit of all projects |
| **Tendering & Evaluation of Proposals:** | **Public call for tender followed by independent anonymous evaluation by experts** |
| Competitive Tendering | After adoption of the Workplan, the choice of proposals was made on the basis of two public tenders (02.07.88 and 15.04.89) |
| Conditions for participation | Two independent partners not all established in the same Member State, one of the partners must be an industrial undertaking and 50% must be contributed to finance by partners. |
| Technical Managerial Evaluation | Proposals submitted were unanimously assessed by independent experts. |
| Strategic and Political Evaluation | With Member States via the DRIVE Management Committee |
| | A Model contract is offered which has been developed with sector actors. It is used for all contracts, although some adaptations are made to accomodate specific problems |
| Monthly Management Reports | This serves essentially the needs of Project Consortia to monitor progress of work and identify problems |
| Red Flag procedure | If a project or a partner in a project encounters unforeseen serious problems he signals this to partners and the Commission by "raising a Red Flag" in the Monthly Management Report. If invited the Commission calls a meeting to resolve the problem, otherwise the issue is addressed within the consortium. |
| Yearly Project Progress Report | Each project prepares once a year an Annual Report |
| Annual adjustment of the Project | After one year, the Technical Annex of the contracts are reviewed and adapted for the following period |
| Adjustment in the course of the year | Adjustments can be carried out in th elight of the results of the "concertation meetings" |
| | Unless these are major changes they are agreed with the Project Officer and recorded without amendment of the contract |
| Deliverables | Quality and timeliness are verified by Project Officers and as part of the Technical Audit |

Review Summary Table DRIVE Programme

| DRIVE Auditing: | **Follows industrial practice conform to Community rules** |
|---|---|
| Mid-term review | Communication reviewing the progress of DRIVE against the objectives stated in the Decision. It is based on the results of specific "audits" addressing the strategic, technical and managerial, and financial performance |
| Strategic Audit and Requirements Assessment | Done by independent experts as a basis for the DRIVE mid-term review and revision of the Framework Programme it examines DRIVE with respect to strategic and policy objectives of the Community in an international context. |
| Technical Audit | Evaluates the performance of all DRIVE projects with respect to specific objectives. |
| Management Audit | Evalautes the performance of the Commission in its responsability for the management of the programme |
| Financial Audit | Verifies the correct use of public moneys. Projects and the Commission service in charge of DRIVE are investigated. |
| **Exploitation of DRIVE Results:** | **Is part of the contractual commitment of the projects** |
| Industrial property rights | Rest with the partners in a project. Depending on the circumstances special provisions are agreed between the partners. The Model Contract considers graduated provisions for access to the results of other projects and the conditions for exploitation. |

DROUT

## 3. The audits of DRIVE

### 3.1 Introduction

This section begins with an overview of the evaluation process employed by the Commission in relation to DRIVE. The results of the audits conducted are summarised and the general impact of the results on the Community is described.

### 3.2 Evaluation as an on-going process

In view of the rapid developments both of technology as well as of user requirements, evaluation is a process which is pervasive in the preparation of the programme, its implementation and its execution.
The evaluation started with the collaboration of the transport industry and public administrations in the planning of the programme and the development of the Workplan. Following the initial definition of the Workplan, there has been a yearly up-date of the both the Programme Workplan and the workplans of all projects. In addition, there is throughout the year a continous informal process of monitoring progress and adjusting the direction of projects and the Programme. The mechanisms used in this process are regular meetings between the consortia making up the programme (Concertation Meeting), a special team monitoring the consistency of work (Systems Engineering and Consensus Formation Office) and close relations with the standardisation bodies making use of the standardisation related results.

The Commission staff is contributing to the awareness of world-wide developments by their contributions to Impact Assessments and Forecasting. This activity provides the factual background for the yearly up-date of the work under the programme as well as minor adjustments during the course of the year. The Member States are involved in the Impact Assessment and Forecasting and participate in reviewing the evolution and assessing the needs for adjustment.

### 3.3 The Programme Audits

The mid-term review of the Programme (18 months review) is based on the outcome of several audits of the Programme by groups of independent experts.
Article 9 of the Council Decision states: "The result of the programme shall be reviewed after 18 months. The Commission shall report to the Council and the European Parliament on the results of this review." By Article 6/3, third ident, the Commission is to refer the programme review to the Management Committee for opinion.

The work on road transport informatics needs to be reviewed both with respect to evolving demand and new technological developments. Three related but distinct evaluation processes need to be addressed:

- **The strategic aspects**, evaluating the performance of DRIVE as a whole with respect to strategic and policy objectives of the Community in an international context.
- **The technical aspects**, evaluating the performance of the projects with respect to the specific objectives, and
- **The programme management**, evaluating the performance of the Commission in its responsibility for the management of the programme.

These audits have been complemented with a forward looking investigation of future requirements and options in the framework of "Operation 1992" in which leading strategy, policy and technical experts collaborated in the task of identifying requirements and options. A summary of the Requirements Board recommendations are enclosed as an Annex to this document.

3.4 The achievements on the specific objectives of the programme

In Annex 2 of the Decision, paragraphs 5, 6 and 7, the specific objectives for Part I, Part II and Part III of the programme (Annex I of the Decision) are specified. The table below summarises the ways in which DRIVE addresses these objectives and the expected impact.

*Review Summary Table*

| Objectives | Ways in which DRIVE addresses these objectives | Impact |
|---|---|---|
| *Objectives of Part I : RTI Technologies* | | |
| Explore the key technologies which might be employed so as to maximise the cost/performance ratio | Assess alternative strategies on traffic control and transport management | Higher performance of traffic control systems for public transport and freight transport reduced pollution and noise production. |
| | | Demonstration of the need and the way to integrate route guidance techniques, real time traffic control techniques, access control techniques to traffic control systems |
| | Assess alternative technological solutions on interurban and urban control | Knowledge of the feasibility and value of cooperative driving and Prodyn algorithm for traffic light control and motorway flow management |
| Select technologies which are sufficiently mature for implementation in the time frame envisaged | Evaluate the technical feasibility of alternative intervehicle and vehicle-infrastructure communications | Evaluation report of short range communication with technologies and synthesis of potential implementation |
| | Develop incident detection, artificial intelligence (AI) techniques | Improve traffic control by developing knowledge based systems prototypes for traffic control systems |
| | Develop demand management techniques | Less congestion in urban areas by limiting the traffic and organising parking facilities. |
| | | Use of traffic restraint policies to adapt demand to offer |
| Allow for later extension to wider functions | Develop appropriate road database management structure | Integration of map and traffic related information for route guidance and navigation purposes. Realisation of a benchmark test to evaluate different data production techniques. Further elaboration of the DEMETER standard for road and traffic databases. |
| | Examine the telecommunication and information processing infrastructure | Intensive use of existing or forthcoming communication systems. |
| | | Recommendations on optimum methods and systems of providing RTI service, being satellite, cellular or new systems |

*Review Summary Table*

| Objectives | Ways in which DRIVE addresses these objectives | Impact |
|---|---|---|
| | Develop appropriate protocols for roadside-vehicle and inter-vehicle communications and between TCCs | Standardisation of communication protocols.<br><br>Specification development and adaptation of technology |
| Increase of safety | Examine the human factor, user behaviour and reaction on new RTI-systems | Quantification of the changes which RTI will bring out as a basic input for evaluation and modelling activities and to be used by traffic control developments. |
| | Man-machine interfaces and standards | Recommendations for the development of in-vehicle equipment and standards for MMI, so that the different RTI systems are integrated to form a coherent total system. |
| <u>Objectives of Part II : Evaluation of strategic options</u> | | |
| Implementation strategies identified in Part I against objectives and against functional requirements of sector actors, using the criteria already mentioned (ie. cost/performance ratio, market penetration, regulatory constraints, synergy etc.) and to use the results to generate viable scenarios for an implementation strategy. | Build an integrated model structure appropriate for RTI policy analysis including a set of evaluation criteria | Production of a set of modelling criteria and guidelines for evaluation. |
| | Building simulation systems suitable for testing RTI systems performance in urban and interurban areas | Production of a dynamic traffic test model and simulation system for RTI applications with specifications for a data transmission and management system. |
| | Evaluate changes of behaviour due to RTI systems introduction | Production of models to assess user reaction |
| | Assess long-term impacts of RTI strategies on land use, activity patterns and the European transport industry | Production of appropriate models |
| | Design of appropriate evaluation framework using the same criteria and under the same assumptions where the results of cost/benefit analysis will be inserted into framework of a multiple criteria-orientated evaluation | Specification, including sensitivity studies and results of test production |

*Review Summary Table*

| Objectives | Ways in which DRIVE addresses these objectives | Impact |
|---|---|---|
| | Systems engineering and concensus formation work including the participation of all actors concerned | Elaboration of implementation scenarios and evaluation of the expected impact in terms of market introduction, investment costs and user benefits. Follow-up of the results emerging from DRIVE projects and achieve consensus on strategie and implementation issues. |
| | Development of a strategic techno-economic model | |
| Objectives of Part III : Specifications, protocols and standardisation | | |
| Establish protocols for signal propagation and information interchange | DRIVE communications systems architecture handbook. Proposals for the further development of telecommunications network structures and standards which are necessary to support the IRTE. Protocols for interfacing DRIVE applications to existing/ planned systems | Establishment of the relevant capabilities of existing & planned public mobile communication systems for DRIVE applications |
| | Comparative evaluation of existing and planned techniques concerning short range road to vehicle communications links | Recommendations for European standards concerning short range road to vehicle communications links |
| | Analysis of potential of GSM for RTI uses | Recommendations for specifications of an RTI system based on cellular radio |
| | Delivery and testing of a microwave link prototype for automobile two-way communication between vehicles and the roadside | Standardisation of microwave communication technology and protocols |
| Define signal properties which are required to permit the system to operate in a satisfactory manner | Proposal on error correction schemes | Production of DRIVE system architecture handbook |
| Define specifications for data collection and promulgation | Assessment report on the basic data acquisition techniques for use in RTI systems | Decision on the most promising technique for further study |
| | Specifications for an integrated traffic data transmission and management system | Include system architecture, data organisation, transmission networks and protocols. |

3.5 Review of the results of DRIVE by the Audit Panels

The main conclusions of the review can be summarised as follows :

* **Strategic orientation**

  The review of the strategic orientation of DRIVE by the sector actors and the DRIVE Management Committee has confirmed the orientation and identified the specific requirements for the coming years.

* **Projects-achievements and outlook**

  The achievements of all projects has been audited by external experts (Technical Audit) and has refocussed the programme overall.

* **Programme management**

- The DRIVE programme has largely adopted an industrial programme management approach. The conclusion of the Management Audit was that **the main elements of this approach**, namely

  > workplan preparation in close cooperation with sector actors

  > importance given to system engineering aspects

  > consensus making through information exchange

  **are on the whole appropriate and well-adapted to the typical objectives and general situation of the programme.**

- **The system engineering part is considered of prime importance to the extent that without it the whole action of the Community through these programmes would be severely restricted in its effectiveness.**

- The **negotiation** process was on the whole seen as **satisfactory** but payment of the advance on contract signature needs to be done faster; the same goes for payment after approval of deliverables.

- **Cooperation among projects towards consensus on technical aspects** is being promoted by regular **Concertation Meetings**, attended by representatives of all projects. The **cost-effectiveness of these Concertation Meetings could be improved** by making them more attractive and more interesting; they could then be organised **less frequently.**

- **The concept of having special projects to take care of system engineering and consensus formation is considered to be vital.**

Conclusion :

**The Audit Team considers the management approach that DG XIII/F applies to RACE, DRIVE, DELTA and AIM to be both original and appropriate; it is highly successful in accomplishing the specific and general objectives set for the programmes; in several aspects it distinguishes itself favourably from what - in the experience of the Auditors - is normally found in comparable programmes and initiatives.**

**The overall impression is unequivocally good, even very good. Any remaining difficulties are of a minor nature. The Commission, in particular DG XIII/F, should definitely continue in its application of this approach, taking care to make the necessary improvements and adaptations as the programmes evolve.**

## 4. Future Requirements and options for work at European level

The very fact that the first Call has engaged so many groups and brought so many requirements and options for the future in full daylight represents a strong rationale and an interesting background for a fruitful outcome of follow-up activities. This opportunity deserves exploitation in the light of the objectives of the DRIVE Action.

Several further key research and development issues have arisen from a review of the results of the Call or have already been identified through the first results of the projects and the «DRIVE Operation 1992» exercise, where all actors have participated in a continuous effort to define the requirements and options for European collaboration.

The preliminary work undertaken in DRIVE and the related EUREKA actions in this domain, in particular Prometheus and Carminat, are proving that fast developing electronics, information and communication technologies enable greater efficiency to be obtained and offer new capabilities:

- in integrating one system with another
- in improving the quality of service provided by new products
- in the transport, information and communications markets
- by providing solutions to cope with problems of ever increasing congestion and pollution
- by improving the reliability and safety of vehicle operations.

Industry has recognised the capabilities listed above at an early stage and has proposed RTI-based systems and solutions. The market for the in-car equipment is enormous and will triple by the end of the 1990's. By then RTI is expected to take up 10 to 15 % of the total car costs. However, the various industrial developments in the area are generally not compatible.

DRIVE has shown that a strong will exists within industry to develop new RTI systems. However, further European R&D cooperation work is needed to develop DRIVE's results into operational projects.

Due to the high complexity and interactiveness of the various issues related to the development of novel RTI systems, the comprehensive systems approach followed in DRIVE must further be developed in setting up any new action.

Basic research and systems engineering work will still be needed, but the main effort of a New Activity should be centered around field trials. These are indispensable because no former information is available on industrial applications on a similar scale especially regarding the potential effects on travellers. Full scale field trials should provide adequate quantification of technical, economic and social aspects of RTI implementation. Using the results it will be possible to define where to apply which combination of RTI services. For this both the political as well as the technical aspects need to be taken into account.

In this context two major issues have to be highlighted:

- technical compatibility
- interaction with user behaviour.

Compatibility has to be bottom-up, aiming at the largest possible integration, allowing various application schemes befitting the requirements which may differ from actor to actor and from country to country.
Compatibility also means synergy between various applications and various locations. For example, private parking management may interact with public route guidance systems by using the same short range communication link. Local city services have to be interfaced with inter-urban ones as well as with international ones in a Europe without borders. Even where some countries may opt for privately run services and others for publicly operated ones, a user travelling from country to country shall not have to change his equipment to get the available services.

The new research tasks should extend the breadth and depth of the research done in DRIVE and include the development of second generation RTI systems and prototype testing of subsystems.

Any further European R&D cooperation work should address four strategic domains:

- Transport Management and Traffic Control
- Advanced Driver Support and Road Safety Systems
- Communications Technologies, Systems and Protocols
- Systems engineering for the emerging Integrated Road Transport Environment.

However, a purely technical approach is not sufficient for the improvement of the transport system. The fact that these systems can only work by interaction with the user makes it compulsory to include the user reaction into the research process. This can only be done by full scale field trials. They play in this research process the same role as experimentation in scientific research.

Full scale field trials involving the user raise some specific problems. Many of them cannot be dealt with without direct involvement of local authorities. A balance must be found between the local authorities' responsibilities and the objectives of Europe-wide standards and Europe-wide involvement of industry.

The field trials should include the following aspects:

- Vehicle Control
- Demand Management
- Integrated Urban Traffic Control
- Monitoring of Air Pollution
- Integrated Motorway Control
- Public Transport
- Freight Transport
- Trip Planning.

Field trials should include a maximum number of aspects and be concentrated on a limited number of sites in order to allow a study of integration issues.

Compared with DRIVE any New Action should be extended to more active cooperation and participation of all users and operators involved. These include local and national authorities, police, traffic control operators, rail- airline- and other public transport operators, road users, tourism organisations, telecommunication operators and, of course, the automobile and ITT industries.

Application standards, not to be confused with industrial telecommunication standards, will be set up on the basis of the research results. The Community could facilitate achieving these standards.

# ANNEXES

## I. Summary of the report of the Requirements Board on the Strategic Audit of the Programme

*Executive Summary and Recommendations for Action*

The DRIVE Programme is fully justified to be run at Community level as it meets the main objectives:

- DRIVE strengthens the economic and social cohesion of the Community.
- DRIVE enables financial benefits from international cooperation.
- DRIVE addresses problems on an appropriate geographical scale.
- DRIVE can contribute where necessary to the establishment of European norms and standards.

Furthermore the DRIVE Programme is an outstanding example for involving people from a wide variety of backgrounds in each of the Member States and bringing them together in a common purpose.

The necessity of an integrated approach in order to contribute to

- improvements in safety
- improvements in road transport efficiency
- minimization of environmental impact of road transport

was confirmed and strongly underlined.

The coherence of the Programme to the more operational objectives of

- identification of the best choice of systems and best strategy for their implementation
- production of guidelines to which industrial products and European regional infrastructure should conform
- development of standards

was also scrutinized and felt to be well covered as far as possible within the time and financial scope of the current Programme. The implementation of pilot schemes, another objective laid down in the Council decision, could not be pursued, with a number of small size exceptions. While supporting the choice made to spend the relatively modest finance available for covering better the other objectives, the audit team strongly recommends that the implementation of large scale pilot schemes takes first priority in following up DRIVE.

The general coverage of the different identified areas within the DRIVE Workplan by the existing projects and the allocation of resources available was considered as satisfactory. Safety related projects were a possible exception since they do not properly cover an important number of Workplan tasks. It is noted, however, that some projects address many tasks at a general level only and do not include the necessary in-depth analysis. Here, in addition to recalling budget restraints, one may refer to the deliberate choice for an overall coverage. Although this approach was justified for the first stage of an action, a search for more in-depth analysis, even at the expense of overall coverage, is recommended for future work.

The technical audit provided a timely confirmation that most of the projects were proceeding satisfactorily in relation to their objectives. From a strategic point of view, it is recommended that the efficiency of the DRIVE programme be improved by:

- strengthening the effort in the systems engineering approach in order to reconcile potentially conflicting stands
- intensifying the coordination between infrastructure oriented projects and those oriented towards vehicles, within and outside DRIVE
- establishing a central procedure for the approval of proposed standards
- increasing the attention for the market aspects in terms of acceptance by the end users and potential commercial providers of the systems
- enhancing the role of public and private financing in order to elaborate different funding and investment approaches for the implementation of RTI systems
- completing the coverage of the workplan tasks related to safety aspects and improving at the same time the visibility of the objectives and expected achievements of other projects outside DRIVE which contribute to the DRIVE effort in this area
- putting more emphasis on in-depth analysis of those areas which are looked into in a general way only at present, but not necessarily for all these areas.

Some of the last issues will call for additional resources.

The auditors are aware that DRIVE is not in itself a complete solution but needs a follow-up with industry and public authorities. An Integrated Road Transport Environment is not a substitute for policies needed to accommodate transport development. But RTI can bring a much larger variety of practicable options for transport policies and also more flexibility. In this respect it can be a decisive instrument to be used in suitable policies and industrial strategies to achieve the needed breakthrough in safety, efficiency and environmental quality of the transport system. Hence there is a definite need for a follow-up and deepening of DRIVE.

## II. Summary of the report of the DRIVE Requirements Board on future requirements and options.

### 1. Introduction

*1.1 Terms of Reference*

The mission of the Requirements Board is to address on an strategy level future needs and options on Transport Informatics and resulting Services. The scope is to include all industrial, service and technological aspects which are relevant to defining a consistent strategy for actions of sector actors including, where required, the advancing of governemental actions. The scope has to be correspondly comprehensive and take into account the domains of convergence between ITR, Telecom and Broadcasting, including both stationary and mobile usages.

*1.2 The DRIVE requirements board.*

The commission gratefully acknowledges the following individuals who made up the DRIVE Requirements Board.

| | |
|---|---|
| **Traffic Mgmt.** | Gaspar (Roboviaria Nacional - Gestao de Transportes) P<br>Giannopoulos (University of Thessaloniki) G<br>Kildebogaard (The Danish Road Directorate) DK<br>Klijnhout (Rijkwaterstaat) NL<br>Rees (DTP) UK<br>Schroeder (BMFT) D |
| **Automobile Industry** | Karlsson (SECFO/Volvo) S<br>Reister D. (BMW, Research) D<br>Traversi (Fiat Auto) I |
| **IT&T Industry** | Barrett (RIC) UK<br>Brägas (Bosch/ZVEI) D |
| **Public Transport** | Laconte (UITP) B<br>Lauer (CETUR) F |
| **Professional Transporters (IRU)** | Smolders (IRU) NL |
| **Automobile Clubs (AIT)** | Versnel (ANWB) NL |
| **Motorway Organisations** | Parey (Scetauroute) F |
| **Safety Organisations** | Dobias (INRETS) F |
| **Relation to other modes** | Bernard (Community of European Railways) F |
| **Police/Emergency services** | Bergmans (Gendarmerie) B |
| **Banking** | Turro (E.I.B.) E |

## 2. Identification of major needs and technical options

The Requirements Board indicated the major needs that are arising from increasing demand for transportation, both in terms of Transportation systems and Social needs. Solving congestion problems, reducing the negative environmental impact of traffic and safeguarding social welfare (safety and security) remain the basic needs that have to be met.

As regards transportation systems, the Board considers that the main needs centre on problems of mobility, access, efficiency and safety. Economic and demographic trends and indicators such as increasing real incomes and vehicle ownership, changes in production and distribution technologies, cheap fuel, an ageing population and greater leisure time, have combined to raise significantly average mobility levels. The only effective barrier to the continuation of this trend at present is congestion. New RTI systems provide a key to addressing congestion, whilst taking into account road users' desire for maximum access. The efficiency needs of different road users - individual drivers, freight transporters, public transport operators and passengers - are sometimes in conflict. Improvements in the efficiency of the global transport system should be one of the major aims of any New Action. In addition RTI systems can offer assistance to improving road safety in several ways, for instance by better protection of vulnerable road users and monitoring of driver performance and ability. Greater congestion and traffic volumes in the last three years are jeopardising advances in road safety achieved in previous years. Renewed efforts to exploit the capabilities of the new technologies are needed.

Exploitation and diffusion of new technologies requires the successful integration of innovations into the fabric of society. Public acceptance of RTI systems and their functions will be best achieved if key social needs are properly catered for. Attention needs to be given therefore to issues of privacy and security, environmental quality and resource conservation.

Various technical options have been identified, all based on the use of IT&T technologies. The main options are: reduction of congestion through demand management, improved traffic control, route guidance, driver information systems and systems strategies designed to impact modal choice. In addition, certain sectors of, and issues within, the global transport system require special attention and emphasis: more efficient public transport systems, enhanced safety systems, cleaner vehicles, traffic modelling, safety regulations and improved integration of transport modes and networks.

## 3. Background to the New Action

ITT and automotive industries have a strong will to put efforts into R&D in transport. The market for ITT applications in transport is growing with the demand increase of such areas as tourism and just in time manufacturing. The output from the DRIVE programme in the areas of modelling and simulation, behavioural aspects and traffic safety, traffic control, services and databases, telecommunications and evaluation provide a platform from which a New Action can progress towards the Integrated Road Traffic Environment (IRTE). Like the DRIVE programme any New Action should not exist in isolation but in co-operation with other research programmes in the area of road traffic.

## 4. Characteristics of the New Action

The New Action shall be a mixture of short and long term research. It will also combine the results of DRIVE and other research programmes, like Prometheus, into large scale field trials. These field trials should form the basis of the New Action. They shall examine the technical and economic feasibility of proposed solutions, investigate their social acceptance and identify new basic research requirements. A bottom-up approach will be used to achieve the shorter term goals which are more easily identified. A top-down approach will be used for the medium / long term goals which are less easily specified at an early stage. The range of actors involved will be considerably widened from the DRIVE programme.

## 5. Recommended structure for the New Action

The four main tasks for the New Action are basic research, systems engineering, field trials and implementation issues. The Requirements Board recommends concentration on field trials. The field trials are expected to indicate new research needs as well as functional specifications. They will address the systems' integration and evaluation issues that need to be solved for arrival at a coherent Integrated Road Transport Environment (IRTE). Because of the scale and complexity of the systems, systems engineering techniques need to be closely adhered to at all times.

Research tasks will form an integral part of the New Action with new IRTE components, more modelling, evaluation of field trial results and solution of problems revealed by the field trials.

### *5.1 Research*

The basic research of the New Action will examine technical and social fundamentals. The research area is divided into four parts : transport management and traffic control, advanced driver support and road safety systems, communications techniques, systems and protocols and systems approach to the emerging IRTE. The areas of evaluation of new systems and services, socio-economic evaluation, market studies, and implementation issues should receive high priority.

### *5.2 Field Trials*

Because even for conventional systems laboratory testing is often insufficient, field trials need, particularly, to examine the reliability, effectiveness, acceptance and overall safety improvement of the systems developed. The purpose of the field trials is to establish the value of the systems before commitment of investment resources. The choice of location and guide-lines for conducting the field trials will be prepared taking into account the results of DRIVE project V1049 whose role is to provide a manual of recommendations and specifications concerning field trials for RTI services.

Field trials shall be carried out primarily in the areas of vehicle control, demand management and automatic debiting, integrated urban traffic management including air pollution monitoring and access control, integrated motorway traffic management public transport multimodal freight transport, intermodal pre-trip planning, RDS-TMC for driver information and the emergency services. The objective is to quantify the benefits in road and vehicle safety; environmental quality, user convenience, economic gains, and security of people and property.

*5.3 Implementation Issues*

Implementation of RTI systems is heavily dependent on the reaction of regulatory bodies. For this reason priority must be given to systems requiring a minimum of new standards and legislation for their implementation. Rapid updating of systems will be required to overcome problems uncovered by the field trials. Use of tried and tested manufacturing techniques will lead to reduced pre-production delay (lead time) and costs and give rise to more reliable systems. In this way, implementation of RTI developments will take place and yield the expected benefits as soon as possible. Training will be needed for the managers, operators and users of the developed RTI systems.

## III. Technical Audit of the DRIVE projects

### A. The Audit Procedure

To be able to adapt the Programme to the development of technology and to changes in the perception of demand, the DRIVE Decision foresees that each year a workplan is established defining the detailed objectives, the type of projects and actions to be undertaken and the corresponding finance plans.

This implies that the progress of all the on-going projects must be annually reviewed with respect to the objectives and also be compared with the need for the future work to be addressed within DRIVE. The Technical Audit includes the following major elements:

a) The partners in each project carry out a "self-evaluation" by reviewing the project in all its essential aspects and document the results of this evaluation in the Annual Review Report of the Project.

b) The Annual Review Reports are evaluated by independant external experts (Auditors) identified with the help of DRMC. Following the evaluation of the reports the projects are given a "hearing" under the chairmanship of the Commission. The projects had the opportunity to highlight achievements and to outline future work, and after the Auditors, grouped in Panels according to their respective expertise, question the projects so as to complete the picture given by the Annual Report and the Presentation.

c) The Panels consolidate their conclusions and recommendations to the DRMC and to the Commission and document them in the Audit Panel Reports.

d) The Audit Report of the external experts is complemented by an assessment of the contractual deliverables by the Project Officers of the Commission (in general the deliverables are considered confidential and are not disclosed to the Auditors).

B. Technical Audit Team of Audit '89

MM. Abbate (Zeltron), Afonso de Albuquerque (Centro de Analise e Processamento de Sinais), Bayliss (Centre for European Industrial Studies), Boulhol (Agence pour la Qualité de l'Air), Bourkas (Environmental Agency of Athens), Boussuge (SETRA), Calandrino (Università di Bologna), Christensen (Technical University of Copenhagen), Cotta (Esprit), Cuena (Laboratorio de Sistemas Inteligentes), De Brabander (Belgian Road Safety Institute), De Rubinat (ACEC Transport), Docoumetzides (A.D.O.), Frantzeskakis (Technical University of Athens), Gambard (CETUR), Gunnarsson (Chalmers University of Technology), Hamerslag (Delft University of Technology), Hills (University of Newcastle upon Tyne), Hitchcock (SEAL Consultants Ltd), Hoffman (University of Berlin), Irving (Transport & Road Research Laboratory), Jorgensen (Institut of Roads, Transport and Town Planning), Le Maire (Eurotunnel), Leutzbach (Universität Karlsruhe), Marco (SECOFISA), McDonald (University of Southampton), McLoughlin (UCD), Oastler (Traffic Control Systems Unit), O'Flaherty (The National Microelectronics Applications), Padinha (Companhia Portuguesa Radio Marconi), Papageorgiou (Technische Universität München), Pelissier (CETUR), Poignet (CCETT), Ponti (Transystem), Russam (TRRL), Salles (Jutland Telephone), Serres (Laboratoire Central des Ponts et Chaussées), Smolders (IRU), Sparman (SNV mbH), Thorson (INTRA), Tognoni (S.p.A. Autostrada Brescia-Padova), Traversi (FIAT), van Zijverden (Technisch Physische Dienst PNO.TH), Wimmer (Siemens).

C. Results of Technical Audit '89

The first technical audit of DRIVE Projects was held by 44 internationally recognized experts during the second week of October 1989. The hearing has been recorded on video.

The official report of the 61 Projects audited says :

- 41 projects have been recommended for continuation with some observations to be taken into account in the negotiations of the year 2 adaptation of the Technical Annex;
- 14 projects have received support for continuation to compliance with substantial recommendations in the year 2 adaptation of the Technical Annex and/or Management procedures;
- 5 projects have encountered serious observations which has led to the recommendation to consider discontinuation. For these a "Red Flag" procedure has been initiated by the Commission, which will lead to a detailed Technical and Financial Audit.
- 1 project is to be completed within the month of October, but its achievements have given serious concerns to the Auditors. As a result, a "Red Flag" procedure has been initiated.

*Review Summary Table: Projects contribution to DRIVE objectives*

## D. Project Review Summary Statements

| Project | Main deliverable | Impact |
|---|---|---|
| V1001 Integrated Public Transport VSCS | Specification of requirements and standards for a recommended system for a public transport Vehicle Scheduling and Control System | Improvement of efficiency and reliability of VSCSs integrating fare collection, passenger information, priority, etc. with emphasis on on-line functions e.g. schedule adherence and control. |
| V1002 Short Range Microwave Links: Present and Future | Recommendations for European standards concerning short range road to vehicle communication links. | Comparative evaluation of three already developed microwave technologies in the 2.5 GHz, 6.6 GHz and 9.9 GHz bands for short range communications between road and vehicles.<br><br>Comparison of these technologies with other comparative links, like cable systems, infrared links and microwaves in the millimetric spectrum (60 GHz) on the basis of their performances, their cost, their reliability and ease of installation.<br><br>Investigation of the feasibility of a unified link able to fulfill the requirements of road to vehicle and vehicle to vehicle communications.<br><br>Synthesis of the potentialities of microwaves for RTI implementations. |
| V1003 Requirements and System Specification for Dynamic Traffic Messages | Recommendation for the use of dynamic traffic messages | Demonstration of the use and the utility of dynamic traffic messages to provide information to the driver. Proposition for standards for providing information by variable message signs. |
| V1004 Feasibility Study for Monitoring Driver Status | Report about the feasibility of monitoring driver's status. System recommendations. | Demonstration of the necessity for, and the feasibility of, a multiple sensor monitoring device. |
| V1005 PREDICT Pollution reduction by information and control techniques | Report establishing environmental standards within the EC. Assessment of benefits and methods of pollution reduction | Develpoment of a scheme to reduce environmental pollution through traffic operation and control measures |
| V1006 Factors in Elderly People's Driving Abilities | Report about elderly driver's reaction to RTI innovations; implications for driver and road-user safety, and for road and equipment design. | Basis input for RTI system developers, so that any special needs of elderly people's can be taken into account. |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1007 SOCRATES - System of Cellular Radio for Traffic Efficiency and Safety | Recommendations for specifications of "An RTI System Based on Cellular Radio". | Demonstration of the feasibility of dynamic route navigation systems based on cellular radio.<br><br>Show how the proposed communication links can also provide other applications such as hazard warning, emergency calls, automatic vehicle location, road pricing, hotel/parking status, etc.<br><br>Show how the technology developed for cellular radio can be used in simplified equipment for DRIVE purposes. |
| V1008 Strategies for Integrated Demand Management | An optimum system archiecture for an integrated demand management system and a set of optimum strategies | Better control of congestion in urban areas. Study of the use of RTI to applied traffic restraint policies in congested European cities. |
| V1009 Vehicle location systems using satellites | Study report on economic and opeational advantages of using satellites for vehicle location | Findings to use as a decision-base for further research work into low cost systems |
| V1010 PANDORA Prototyping a navigation database of road network attributes | Methodology for network data extraction from digital map. Fiels trials following development and upgrade of GDF standard | Publication of standards for digital road network maps and determination of legal aspects to protect the interests of data providers |
| V1011 Integration of Dynamic Route Guidance and Traffic Control | Strategies and system specifications for an integrated system running together route guidance and traffic control techniques | Demonstration of the need for integrating route guidance system in traffic control centres |
| V1012 Road Safety Management Combining Knowledge Base and Database Technologies | Protoptype of a Road Safety Management Expert System (ROSAMES) | Developement of a database to be used by traffic managers. |
| V1013 Comparative Evaluation of the Different Radiating Cables and Systems Technologies | Report describing the place of the cable systems in an RTI organisation as well as the advantages and inconveniences of these systems compared with their concurrents. | Production of a methodology permitting an easy prediction of the performances of radiating cables on whatever particular site. |
| V1014 IMAURO Integrated model for the analysis of urban route optimisation | Construction of dynamic traffic test model including data acquisition and data base system | Availability of model to test RTI applications in small urban areas such as distance warnings, overtaking aids, etc |
| V1015 Artificial Intelligence Based Systems for Traffic Control | Knowledge Based System Prototypes for Urban Traffic Control | Demonstration of the need and application of solutions provided by artificial intelligence to solve traffic control problems in urban areas. |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1016 INFOSAFE An Information System for Road User Safety and Traffic Performance | Prototype of an INFOSAFE Expert System | The framework of the information flow to the driver, will allow traffic managers to increase safety on traffic performance. |
| V1017 Changes in Driver Behaviour due to the Introduction of RTI Systems | Report on the strategy for information dissemination and programmes, and description of behaviour changes due to the introduction of RTI systems. | Quantification and evaluation of the behavioural changes which RTI will bring out as a basis input for evaluation and modelling activities. |
| V1018 TARDIS The Total Traffic Management Environment | IRTE functional requirements, recommendations for standardization | Coordination and integration of all RTI subsystems |
| V1019 CASSIOPE Computer-Aided System for Scheduling, Information and Operation of Public Transport in Europe | Specification of requirements and demonstration of a second generation computer aided system for scheduling and control of urban public transport systems. | Improvement of efficiency and reliability of VSCS's with emphasis on off-line functions e.g. timetable planning, vehicle and driver scheduling etc...<br><br>-Asess benefits of new generation integrated VSCS |
| V1020 Tidal Flow Systems | Development and demonstration of tidal flow systems in Lisboa and Barcelona, recommendations for implementation and operation | Demonstration of the efficiency of tidal flow systems to increase the capacity of the existing road infrastructure |
| V1021 Task force "European Digital Road Map" | Proposal for a European standardisation procedure, Detailed report on logistical problems of data manufacturing, road database, and traffic management. Benchmark test booklet and analysis report | Technical framework for the production of a common roadmap and a proposal for a European standard |
| V1022 Realisation of a Real Time Urban Traffic Control System | Specification of a traffic control sytem for one or several intersections and for the central unit equipment | Demonstration of the industrialisation need of Prodyn algorithm |
| V1023 EUROTOPP A new, integrated RTI oriented transport planning process | Software and manual of tools to aid traffic forecasting and planning during and following the introduction of RTI systems | Provision of updated tools and models to enable accurate planning following RTI introduction |
| V1024 Driver Information System | Report on the strategies for and architecture of information systems. System specifications and recommendations | Integration of existing systems into one Europe-wide system |
| V1025 EURONETT Evaluating user reaction on new European transport technologies | A suite of sub-models including activity patterns, travel choice and psychological models and an umbrella model for long term forecasts | Researched and proven models incorporating RTI effects on user behaviour |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1026 INVAID Integration of computer vision techniques for automatic incident detection | Prototype of an incident detection system and field trial | Improving road safety and road transport efficiency by improved traffic monitoring using computer vision techniques |
| V1027 EUROFRET A European system for international road freight transport operation | Review of existing systems, preferred strategy and recommended organisational structure for users | Proven and researhed strategies for future implementation, with critical functions specified and investigated |
| V1028 TUNICS Tunnel integrated control system | Recommendations for the architecture of an integrated tunnel control system and recommendations for field trials | Demonstration of the possibilities of RTI for improving tunnel transport safety and efficiency |
| V1029 Standards for RDS-TMC throughout Europe | Guidelines for location coding and message sets. Software development for message generation and evaluation of decoding methods. draft supplement to EBU RD2 specification | Progress towards standardisation and improved application for road transport |
| V1030 PAMELA Microwave Communications for Traffic Monitoring and Pricing | Delivery and testing of a microwave link prototype for automatic two-way data-communication between vehicles and the roadside. | Demonstration of the potential of a microwave link for identification, monitoring, control and pricing of traffic. |
| V1031 An Intelligent Traffic System for Vulnerable Road User | Computer model | Creation of a set of tools for traffic management to enhance the safety and mobility of vulnerable road user. |
| V1032 STRADA - Standardisation of traffic data transmission and management | Specifications of an integrated traffic data transmission and management system including system architecture, type of data, data organisation for retrieval, transmission networks and protocols. | This project will allow the CEC to reach an agreement relating to traffic data collection, coding, management and transmission. |
| V1033 AUTOPOLIS Automatic Policing Information System | Recommendations for the development of on-site and in-vehicle prototypes | Determination of the technical potential of, and requirements for, automatic policing systems that will be able to warn the driver and prevent unlegal behaviour. |
| V1034 Road Information and management EURO system | Synthesis report on state of the art. Recommendations, guidelines and standards for RDB technology | Further research into roads database and recommendations for standards |
| V1035 CHRISTIANE Motorway traffic flow monitoring and control | Prototypes of linear and network motorway control and field experiments | Definition of automatic control techniques for the control of motorway network |
| V1036 Evaluation process for road transprt infomatics criteria, methods, test production | Evaluation frmework, sensitivity studies and results on test rpoduction of reference candidates | Guarantee that all evaluation work is carried out using the same criteria, allowing results to be compared like for like. |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1037 STAMMI Definition of Standards for In-Vehicle Man Machine Interface | Draft standards for in-vehicle man machine interface | Standards for in-vehicle MMI, will ensure that the various elements of the different RTI in-vehicle systems are integrated to form a coherend total system. |
| V1038 DACAR - Data Acquisition and Communication techniques and their Assessment for Road transport | Assessment report on the basic data acquisition and communication techniques for use in RTI systems. | A recommendation on the applicability and suitability for RTI will give the CEC the possibility to select at an early stage the most promising data acquisition and communication techniques. |
| V1039 Survey of Potential Applications of Artificial Intelligence to Solving Traffic Engineering Problems | Report on potential use of AI techniques for traffic engineering | Improvement and guidance for the introduction of artificial intelligence techniques to traffic engineering |
| V1040 Safety Scenario - Identification of Hazards | Report on the formulation of safety objectives. Design of different models to predict the hazard situations in which RTI techniques are likely to have their maximum effect. | Basis input for other traffic control projects. |
| V1041 GIDS Generic Intelligent Driver Support System | Specifications and a GIDS prototype | Design and standards recommendations for a class of intelligent co-driver systems. |
| V1042 Accident Data Collection and Analysis | Prototype expert system for in-depth accident data analysis. | Traffic controlers will use this multi-stage accident documentation process for future developments in traffic safety. |
| V1043 CIDER - DRIVE Integrated Telecommunications | Drive communications system architecture handbook.<br><br>Model for dimensioning and optimising the telecommunications and information processing infrastructures. | Establishment of capabilities of existing and planned public mobile communication systems for DRIVE applications.<br><br>Proposals for further development of telecomms network structures and standards necessary to support the IRTE.<br><br>Proposal on error correction schemes.<br><br>Recommendations for extra-urban signalling and communications systems.<br><br>Recommendations on optimum methods and systems for dealing with information flow in an IRTE in a cost-effective manner. |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1044 FLEET Freight and logistics efforts for European traffic | Fleet management requirement specifications and outlook for system design, implementation scenario and proposed standards. Demonstration project and specifications | Design based upon analysis of available and potential systems to produce an optimal design |
| V1045 PARCMAN Parking Management, Control and Information Systems | Specifications of parking information networks, standard framework for parking control, specification and design of the information system and demonstration prototype | Demonstration of more efficient parking management systems |
| V1046 FRIDA Framework for integrated dynamic analysis of travel and traffic | Modelling framework with evaluation criteria and guidelines for optimal use, including results of sensitivity tests of modelling framework | Behaviour model for travel and drivers to test RTI based policies |
| V1047 ODIN Origin-destination information versus traffic control | Urban and extra-urban dynamic algorithms to achieve and use origin/destination information | Better adaption of traffic control to main traffic streams |
| V1048 DOMINC Advanced control strategies and methods for motorway RTI systems of the future | Comprehensive analysis of the problems related to feasibility and introduction of convoy driving | Study of the feasability of introducing co-operative driving |
| V1049 Field trials | Manual of recommendations and specifications concerning field trials for RTI services | Basis for the field trial stage of relevant DRIVE (and future) projects |
| V1050 DRACO Driver and Accident Coordinated Observer | System and equipment including devices for postevent analysis. | To provide data which can be used by the driver and traffic controlers to reduce the number of accidents. |
| V1051 Procedure for Safety Submissions for RTI Systems | Evaluation of safety relevant functions of electronic RTI systems; proposal for a procedure for safety submissions for RTI systems | A support to standard definition activities that will be required for computer hardware and software components for use in road transport systems. |
| V1052 ICARUS Interurban control and road utilisation simulation | Reports on finalisation of models, completion of simulations and estimates of RTI effects | Recommendations on analysis of the connection between RTI systems and speed, flow and capacity on interurban roads |
| V1053 Modelling of emission and consumption in urban areas | A model of exhaust on noise emissions and fuel consumptions, and a set of driving cycles in urban areas | Mathematical models proven by practical testing showing the effects of enhanced traffic control systems on pollution |
| V1054 System and scenario simulation for testing RTI systems | Development of an integrated traffic simulation system for testing RTI systems in large urban areas complete with user manual | New software to estimate the quantative effects of the impact of introduction of RTI systems |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| V1055 AI Techniques for Traffic Control | Development and testing of AI prototypes for traffic data collection, data analysis and interpretation, traffic prediction and traffic control | Application of solutions provided by artificial intelligence to traffic control problems. |
| V1056 MONICA System integration for incident-congestion detection and traffic monitoring | Strategies for urban and extra-urban strategies for automatic incident detection, software for one system based on UTC sensors | Improved traffic safety and road transport efficiency by improved traffic monitoring |
| V1057 SECFO Systems engineering and concensus formation office | Team structure monitoring DRIVE projects and producing status reports, programme analysis reports and impact analysis reports | Integration of systems and standards throughout DRIVE, and development of a long term implementation plan |
| V1058 CROW Conditions of road and weather | System architecture for road and weather monitoring systems, prototypes for crosswind, loss of friction and visibility | Improved traffic safety by improved monitoring of driving conditions |
| V1059 SPECTRUM Strategies for preventing road traffic congestion | Recommendations for strategies for prevention of road traffic congestion | Applicability of strategies for preventing traffic congestion |
| V1060 SMART Electronic cards for travel and transport | Specification of the most promising applications of smart cards | Use of new smart cards possibilities to improve exchange between users and their transport means |
| V1061 Improvement of Pedestrian Safety and Comfort at Traffic Lights | Pedestrian detectors, algorithms, recommendations on traffic control strategies | Development of new sensors for pedestrians for traffic control systems. |
| P6600 Inter-Vehicle Communications | Development of a clear and precise framework for future standards for mobile-mobile communication. | Rationalisation of procedures and prenormative definition of criteria to be available as a basis for possible future development work |
| P6601 PULSAR Parking Urban Loading Unloading Standards and Rules | Recommendations and guidelines for technical and legal modifications | Solutions for avoiding congestion through parking and loading vehivles in urban areas |
| P6602 UROP Universal Roadside Processor | Design of an architecture for a roadside processor and development of a prototype | Tool for decentralised RTI applications will be available, with proposals for field testing and background analyses on interface and attachments to external RTI components. |
| P6603 Car Pooling System Management | Development and demonstration of car pooling systems in a metropolitan area and in rural areas | Identification of gaps and shortcomings of present procedures,and use of RTI techniques to realize car pooling system management |

*Review Summary Table: Projects contribution to DRIVE objectives*

| Project | Main deliverable | Impact |
|---|---|---|
| P6608 STRADA II Standardisation of Road Data Transmission and Management. | Design and realisation of full scale STRADA model, building on research developed within the original STRADA project. | Recommendaions will be produced in the fields of administrative, technical and economic management in order to implement the network throughout Europe. |
| P6636/6660 EUROTRIP European Trip Planning System | Development of a prototype and field test of a Trip Planning System | Trip Planning facilities to be used by various groups and actors in the transport field |
| P6661 Implementation Aspects in Planning and Legislative Issues | Analysis of problems and recommendations in respect to standardisation and legislative changes for the introduction of RTI Systems | Identification of actions to ensure an effective introduction and function of RTI Systems in Europe |
| P6663 Multi-layered Safety Objectives | Analysis of factors causing accidents, development of models, and formulation of multi-layered safety objectives | Identification of situations where RTI interventions can improve road safety |
| P6664 CHRISTINE Characteristics and Requirements of Information Systems based on Traffic Data in an Integrated Network Environment | Recommendations for Data Exchange | Improved information flow between traffic control and operation centres |
| P6667 SIRIUS Sociopolitical Implications on RTI Implementation and Use Strategies | A "pollution advisory software for traffic controllers. | A scheme for reducing environmental pollution in Central Business Districts through use of traffic operation and control measures: it will support the assessment of environmental standards. |
| 6605 PARIS Project for the economic Assessment of Road transport and traffic Information Systems. | Recommendations on the choice of RTI technologies. | Quantitative (using econometric modelling) and qualitative assessment of the matrix of RTI related industry, will contribute to undertand the effects of technical decisions on European industry competitiveness. |
| 6606 FIORE: Funding and Investment Objective for RTI in Europe. | Assesment of RTI systems financial performance. | The project will market key financial ideas to potential investors sources. |
| 6667 SIRIUS: Sciopolitical Implications of RTI Implementation and Use Strategies. | Recommendations for introducing and phasing RTI policies in different European environments. | A set of structured tests of target-groups of actors (both from the supply and demand side) will assess their sensitivities to relevant RTI based policies. |

## IV. Programme Management Audit; Executive summary and main recommendations for improvement

### Executive summary*)

*A. The Audit Procedure*

**It is important in any research and technology development programme that there is regular and effective evaluation.**

The Council Decisions covering the Framework Programme and the specific actions under it (including RACE, DRIVE, DELTA and AIM, for which DG XIII/F is responsible) imply a **systematic evaluation/review of the performance with respect to strategic and policy objectives, precise technical objectives and programme management.**

To address the first two aspects, DG XIII/F organises Strategic and Technical Audits on a regular, yearly basis. The **Management Audit that is the subject of this report covers the third aspect; it needs to be done only once in the lifetime of each programme,** before the Mid-Term Review, and at a time when most projects are still in their early stages, so that results can be fed back into the operation.

Because of the uniform management approach of DG XIII/F it was possible to hold **one common Management Audit addressing all four programmes.** The Audit was performed in the period June-September 1989 by a **team of independent experts,** chosen for their direct experience in the essential programme management operations. It addressed the whole "life-cycle" from workplan preparation through to contract execution.

A set of questions was sent to all project partners and to a selection of representatives of rejected proposals; this written enquiry was supplemented by interviews with project managers and Commission project officers.

*B. The Management Audit Team*

Mr. A. Vyverman, ASCENT Consultancy (Chairman)
Prof. C. Salema, JNICT (Vice-Chairman)
Mr. W. Collin, NCC
Prof. L. Donato, CNR
Prof. J.-L. Funck-Brentano, Hopital Necker
Mr. H. Giertz, Ericsson
Mr. J.J. Jimenez Lidon, Telefonica
Mr. A. Lauer, CETUR
Prof. W. Lenz, BAST
Mr. C. Ouannes, Min. Rech. et Technologie[1])

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*) For full details please refer to Programme Management Audit Report

1) Participated until 1 September 1989, and withdrew from Audit Team after that date, for personal reasons.

*C. Results of Programme Management Audit*

**As a general conclusion, the Audit Team considers the management approach that DG XIII/F applies to RACE, DRIVE, DELTA and AIM to be both original and appropriate; it is highly successful in accomplishing the specific and general objectives set for the programmes; in several aspects it distinguishes itself favourably from what - in the experience of the Auditors - is normally found in comparable programmes and initiatives.**

* * * * * * * * * * *

**The overall impression is unequivocally good, even very good. Any remaining difficulties are of a minor nature. The Commission, in particular DG XIII/F, should definitely continue in its application of this approach, taking care to make the necessary improvements and adaptations as the programmes evolve.**

In pronouncing itself on the **general appropriateness of the management approach** the Audit Team has taken into account not only the **precise objectives of each programme**, but also - and even mainly - the **wider objectives** of the Community Framework Programme and of the Communities as a whole, of which these objectives are a part.

The first conclusion was that **the main elements of this approach**:

- workplan preparation in close cooperation with sector actors
- importance given to system engineering aspects
- consensus making through information exchange

**are on the whole well-adapted to the typical objectives and general situation of the programmes**, and that any improvements to be made are of a minor nature.

**The system engineering part is considered of prime importance to the extent that without it the whole action of the Community through these programmes would be severely restricted in its effectiveness.**

As regards promoting awareness of the programmes with potential proposers, the physical and logistic effort spent by each of the Central Offices is at the limit of what can be done with current staffing levels.

Available data show that a **wide and balanced participation in the programmes has been obtained.** However, while this goal is certainly very important, the Audit Team is of the opinion that **quality of participation should have precedence** after all. The way the **programmes are prepared and the way the technical evaluation is handled satisfy this requirement.**

On the basis of the information available to it, the Audit Team notes that **the programmes are on the whole well-structured and well-managed.** Consequently, its general **recommendation is for DG XIII/F to continue to apply this approach to the management of RACE, DELTA, DRIVE, AIM** and any future programmes of similar nature.

At the same time, the Team has pointed out a number of detailed issues where improvements can be made, that will enable the programmes as a whole to perform even better in reaching their objectives.
These detailed issues include in particular*):

- efforts to promote and explain the programmes well-ahead of Calls for Proposals;
- reaffirmation of the evaluation procedures, so as to avoid misunderstandings and disappointment;
- payment of the advance on contract signature;
- cost-effectiveness of Concertation Meetings;
- functioning of the system engineering and consensus formation projects;
- optimum size of consortia
- efforts to disseminate information

On the other hand, it was noted that:

- the preparation of the workplan is successful in achieving a workplan which reflects the priorities of the sector
- the negotiation process was on the whole seen as satisfactory
- there are no major problems with monthly control reports and Technical Audit
- the role of the Project Officer is judged to be well-performed

Main recommendations for improvement

**The general recommendation is for DG XIII/F to continue to apply its approach to the management of RACE, DELTA, DRIVE, AIM** and any future programmes of similar nature.

**The efforts of the Central Offices to inform potential proposers and to promote awareness of the programmes are generally appreciated.** There are indications of a **positive correlation between proposal acceptance and awareness of the programme during the preparation stage.** This suggests that especially in the earlier years of a programme, when the circle of those who are directly involved is necessarily small, **more should be done to promote and explain the programme well-ahead of a Call for Proposals.**

**It is necessary to reaffirm the procedure for evaluations, so as to avoid any possibilities for misunderstanding and disappointment: the procedure as currently practiced should be rigorously maintained, and potential proposers should be made more aware of it.**

**The procedure of having advance payments is considered a good principle.** However, in practice **payment delays** are a source of problems; **the Commission is urged to take the necessary steps to correct this situation. In case the delay remains important the partners' additional cost of financing should be allowable under the contract.**

**The Concertation Meetings are a very good forum for information exchange and to promote contacts, and their function is an essential element in the execution of the programmes.** Because the Concertation Meetings are very expensive (travel costs and time spent away from work), **one should do everything to make them more attractive and more interesting. Better prepared Concertation Meetings could be organised less frequently.**

*) A summary of the main recommendations is given below

**The concept of having special projects to take care of system engineering and consensus formation (as concretised in RACE and DRIVE already) is vital. However, the experience gained so far in RACE is that these projects do not perform optimally.**

**The topic of Information Dissemination is still addressed insufficiently.**

**One should be careful not to create projects with more partners than are needed to provide the resources required. In general 5 to 6 partners is the practical limit, except for pre-normative and coordination-type projects.**

## V. Summary description of DRIVE

### A. Call For Proposals

The tasks to be carried out in the programme are described in the DRIVE Workplan. The Workplan was written by the European Commission in consultation with the Member States, interested parties in industry and representatives of road user organisations. After final adoption of the programme by the Council of Ministers, the Workplan was approved by the DRIVE Management Committee on the 29th June 1988 (the Management Committee is made up of two representatives from each Member State and is chaired by the Commission).

The workplan formed the basis of the Call for Proposals which was published in the Official Journal of the European Communities on 2 July 1988. The Call for Proposals asked proposers to form project consortia to carry out a task or groups of tasks from the Workplan working under the rules established by the Community's 'Framework' R & D programme. The closing date for proposals was the 17th October 1988.
An additional call on a small remaining number of tasks was launched in April 1989 with closing date 12th May.

### B. The Response to the Call

The response to the Call was outstanding - 214 proposals were received totalling about 540 MECU of work (requiring a 290 MECU Community contribution) which involved some 5200 man years of effort. Overall there were 1050 offers to participate in DRIVE which came from around 750 separate organisations including manufacturers, universities, research institutes, user groups and others.

Careful design of the Workplan, coupled with detailed specification of the work expected, has resulted in the majority of proposals being of high quality that met the stringent criteria for acceptance. In particular:

- many proposals were vertically integrated in terms of their participants - in other words they included all actors typically involved with the introduction of a new technology from research establishments through manufacturing industry to service providers and leading-edge users;

- the range of proposals spanned a representative spectrum of advanced applications in areas such as:

  * *two-way communication systems* (GSM, Infrared, Microwave)

  * *integrated traffic control*

    . strategies
    . applications
    . artificial intelligence

  * *environmental control strategies*

* *road safety*

  . man-machine Interfaces
  . anti-collision systems
  . behavioural aspects

* *advanced public transport and freight systems*

* *evaluation techniques and strategies*

* *systems integration and management techniques.*

- major industrial partners made proposals demonstrating their willingness to collaborate with operators and research establishments on a European scale;
- several proposals may prove to be of strategic significance, in that the involved partners have the role of, and the potential for, contributing to Europe-wide implementation;
- the size distribution of organisations covers the whole spectrum from large companies down to SMEs.

The number of proposals was sufficiently large for effective competition to take place.

Once submitted proposals underwent an External Technical Evaluation carried out by 62 independent experts in the first call and 9 in the second identified with the assistance of the DRIVE Management Committee. The Evaluation recommended the retention of around 30 per cent of proposals amounting to 12,500 man months of work including 1000 man months of effort offered by organisations in EFTA countries. Unfortunately budget constraints meant that some good quality proposals could not be retained and that even successful proposals often had their scope trimmed.

The detailed situation in the different areas of the DRIVE Workplan is reported in the sections 3.2.1 to 3.2.7 below.

*1. Evaluation and Modelling*

To achieve the goal of optimizing RTI applications in Europe, the DRIVE programme is financing the development of suitable tools to simulate and evaluate the effects of RTI implementation.

As a result of the first call, a large number of good proposals were received from European universities, research centres, industrial and consultancy firms to undertake the Workplan tasks on traffic, transportation and evaluation modelling. Mergers were negotiated between some of the proposals in order to have the strongest possible consortia and good technical integration. The projects in this area dovetail together and, where relevant, different simulations and evaluations will be compatible across this part of the programme, in particular:

in **transportation modelling**, an innovative approach was requested in order to forecast and simulate the effects of RTI on transport demand, traffic performance and on the environment. The seven models under development will be dynamic in character and will be based on existing research on perception, driver and household behaviour. These models will also explicitly include the effect of drivers having information about the road environment so that the consequences of partial and imperfect information can be modelled directly;

guidelines for the **evaluation** of RTI systems and trials will be prepared by two consortia working respectively on field trials and evaluation methods and criteria.

The approach of the evaluation projects to their work will be regularly assessed for the Commission by an independent group of experts. Eventually the results of the evaluation projects could be offered to other EC actions as a common tool to allocate scarce resources.

At this stage, work in this area of the programme focuses on the consequences of introducing RTI users and society at large. There is still the need for further research to assess the industrial impacts of the DRIVE programme.

*2. Behavioural Aspects and Traffic Safety*

Improved road safety is expected to be a key outcome from DRIVE activities and an important part of the programme is dedicated to the behavioural aspects of driving as a human activity and to traffic safety. Retained proposals in this area will research the following:

- hazard and accident data analysis, particularly in relation to RTI systems,
- safety for vulnerable road users,
- behavioural changes due to introduction of RTI systems,
- requirements for man machine interfaces and collision avoidance systems,
- data recording for automatic policing using a vehicle journey recorder,
- impact and implementation studies.

The retained projects include both theoretical and experimental work. However, to fully cover the range of research needed in this domain would require a larger research effort than was possible within current financial constraints. As a result certain projects have seen their scope reduced.

*3. Traffic Control*

The projects in the field of traffic control aim to improve the efficiency, and partly also the safety, of the road network by using RTI facilities. One quarter of all the projects received in the call for proposals focused on this area.

The retained projects will contribute to the integrated road transport environment (IRTE) by developing either system components or by working on the integration of those components into a single system. For example one project will define the functional requirements and specifications for the IRTE and will recommend international standards. Another deals with the integration of dynamic route guidance and traffic control systems. The other projects in this area deal with the more detailed components of the IRTE. These are listed below split by topic area.

**Traffic Demand** projects include:

- the development of strategies for demand management,
- management of off-street parking (an important element of urban traffic control),
- investigation on smart cards which could be used for automatic debiting.

**Traffic Control** projects concern both urban and extra-urban areas. In summary there project concerning:

- the development of separate traffic control subsystems such as for tidal flow or for tunnel control (although each subsystem must be integrated into the overall IRTE).
- the improvement of traffic signal control by making use of better origin/destination information.
- using expert systems to advise on appropriate traffic control decisions.
- the use of artificial intelligence (AI) for data acquisition, traffic condition interpretation and prediction (later projects will study other possible applications for AI).
- the definition of system architectures and building of prototypes for new road condition and weather monitoring systems. This project will also make recommendations for the use of this information in traffic management.
- motorway ramp control.
- cooperative motorway driving.

Congestion Control is really a special type of traffic control. Projects in this area concern:

- alternative methods for general incident detection,
- the use of computer vision for general incident detection,
- strategies that should be adopted to prevent congestion from occurring.

*4. Route Guidance, Vehicle Location, Maps and In-Vehicle Information Systems*

Route guidance and in-vehicle information systems are key to RTI and hence in DRIVE. The potential scale of benefits achievable from market driven penetration of such systems and the resultant improvements in traffic control appear to be very substantial.

As a result of the call for proposal, seven projects were started which can be arranged logically into three groups:

- The first group is of 3 projects which deal with digital maps and road network databases. Their scope includes the technical framework for data collection, a benchmark test inputs to the standardization process for geographic data files and the linking of road databases to applications such as route guidance, traffic control and so on.

- The second group is also of 3 projects. These all relate to route guidance and include:
  * the improvement of existing traffic control strategies using information from the route guidance system,
  * vehicle location technologies,
  * standards for RDS-TMC messages.

- Finally, a single project will explore the requirements of in-vehicle information systems and prepare the specifications of the system components and recommendations for European in-vehicle information systems.

*5. Public Transport and Freight Management*

Two proposals were retained and, after some negotiation, became **public transport** research projects:

- one covering the off-line aspects of public transport operation (i.e. scheduling, network planning, management database, etc);

- a second concentrating on real-time strategies and control (i.e. impacts of the traffic situation on operator, driver and passenger information systems, etc). An important contribution is expected from the European public transport operators involved. In the third year of the project a pilot demonstration will show some of the proposed specifications.

In the field of **freight transport** there are two projects which will investigate user and market requirements and set out the functional characteristics of an informatics based system of international road freight operation:

- one project will concentrate on the development of strategies and will produce a comprehensive analysis of the areas where can be used to improve Road Freight Operation.

- the other project will focus on the integration of fleet management systems and prepare technical specifications of the system. Implementation strategies will be considered and a pilot demonstrator will be carried out using existing hardware components to show the main functions.

*6. Telecommunications*

The characteristics of the communications and information processing infrastructure in an Integrated Road Transport Environment (IRTE) will be dependent on a wide range of factors such as the expected data rates, the location and distribution of processing power, the required reliability, resilience and security levels, the protocols to be used to carry traffic-related messages and other factors.

To support this infrastructure there are a number of candidate technologies for the transmission of information between vehicles and the infrastructure and for vehicle to vehicle transmission. These are inductive loops, microwave, infra-red, cables, satellites and new developments may lead to others. The choice of which to adopt as the preferred European implementation will depend on technological factors (bandwidth, range, predisposition to interference) and economics (cost per vehicle, investment needed in infrastructure provision etc.).

As a result of the first call, a significant number of proposals concerning telecommunications systems and technologies for an IRTE were received. They covered all crucial industrial and service sectors. In the manufacturing sector, major European companies are involved (electronic components and systems industry, telecommunications industry and automobile manufacturers) while the service sector is represented by the telecom operators and the road administrations. The universities and research institutes are also very well represented.

Good proposals were retained concerning the development of the necessary RTI communications and information processing infrastructure, the investigation of the pan-European digital cellular radio system as a possible RTI system, the further exploration of microwave technology, the comparative analysis of the different existing and emerging communication technologies and the use of radiating cables in difficult transmission environments (such as in tunnels). Communication standards and protocols for vehicle to infrastructure communication and vehicle to vehicle will also be investigated.

*7. The Systems Engineering and Consensus Formation Office*

Research results achieved in DRIVE projects must lead to effective systems integration. Given the complexity involved, this will be impossible unless an overall and consistent systems engineering approach is adopted from the outset. To support and help guide the operation of this approach amongst the projects, the DRIVE Workplan foresaw the need for a set of 'horizontal' management tasks.

In addition, as a complement to technical systems engineering, there are a range of other tasks which collectively have been called 'consensus formation'. In essence, these tasks are concerned with ensuring continual feedback from the outside to DRIVE projects throughout the life of the Programme with the ultimate goal of recommending a preferred implementation strategy for RTI systems.

As a result of the Evaluation of proposals received under the Call, a consortium has been retained to set up a Systems Engineering and Consensus Formation Office (SECFO) in Brussels. The lead contractor is a major European vehicle producer. The other partners represent the Information Technology industry, public transport, freight operators, motorists organisations & touring clubs, telecommunications equipment producers and traffic control engineers.

Under the rubric of systems engineering and consensus formation the SECFO will address a number of specific problems and objectives including:

- RTI impact analysis,
- modelling of RTI implementation scenarios as a precursor to developing a draft implementation plan,
- preparing draft recommendations for functional standards for RTI systems.

SECFO will not only regularly monitor and report on the work in progress within DRIVE projects but also has responsibility for doing the same with regard to European and international trends in RTI.

## VI. Glossary

| | |
|---|---|
| AA | Automobile Association - UK motorists organisation |
| AI | Artificial Intelligence |
| AID | Automatic Incident Detection |
| ARI | a radio data broadcasting system in use in West Germany |
| ARIAM | a more advanced version of ARI |
| ARISE | Automobile Road Information System Evolution - a Swedish research programme |
| AVI | Automatic Vehicle Identification |
| CCD | charge-coupled device - an optoelectronic sensor |
| CCIR | an organization of the International Telecommunications Union dealing with the world wide radiocommunication standards |
| CCITT | International telecommunications standards body |
| CCTV | Closed Circuit Television |
| CD-ROM | Compact Disc Read Only Memory |
| CEC | Commission of the European Communities |
| CEN | Comite European de Normalisation - a standards body |
| CENELEC | a standards body |
| CEPT | European Telecommunications Administration's technical group |
| CERCO | the umbrella organisation of national cartographic institutes |
| CID | charge-injection device - an optoelectronic sensor |
| DCF | Discounted Cash Flow |
| DEMETER | a Eureka project researching digital mapping |
| DIS | Driver Information Services |
| DRCO | DRIVE Central Office in Brussels |
| DRMC | DRIVE Management Committee |
| EC | European Commission |
| EDI | Electronic Data Interchange |
| EEC | European Economic Community |
| EFTA | European Free Trade Association |
| EIB | the European Investment Bank |
| ENP | Electronic Number Plates |
| ERP | Electronic Road Pricing |
| ERTIS | European Road Transport Information System - a Eureka project |
| ESA | European Space Agency |
| EWOS | European Workshop on Open Systems |
| GIS | Geographic Information Systems |
| GM | General Motors |
| GSM | Grande Systeme Mobile - digital pan-European cellular system planned for the early 1990s |
| HELP | Heavy vehicle Electronic License Plate - a US trial system |
| IBC | Integrated Broadband Communications |
| IBCN | Integrated Broadband Communications Network |
| IEC | International Electrotechnical Commission |
| IMIS | Integrated Motorist Information System - a US UTC system |
| INMARSAT | International Maritime Satellite Organization |
| IRR | Internal Rate of Return |
| IRTE | Integrated Road Transport Environment - the ultimate outcome of the work underway in DRIVE, the emphasis being on Integrated |
| ISO | International Standards Organisation |
| IT | Information Technology |
| IT&T | Information Technology and Telecommunications |

| | |
|---|---|
| ITU | International Telecommunications Union |
| IVU | In-vehicle Unit |
| LCD | Liquid Crystal Display |
| LED | Light Emitting Diode |
| MITI | Japanese Industry and Research Ministry |
| MMI | Man Machine Interface |
| NET | Normes Europeenes de Telecommunications |
| NPV | Net Present Value |
| OECD | Organisation for Economic Cooperation and Development |
| OSI | Open Systems Interconnection |
| PREMID | Philips' automatic toll-collection system in Norway |
| PRO-GEN | PRO-GENERAL - a sub-project of the Prometheus programme |
| PTT | Posts, Telegraph and Telecommunications Authority |
| RACE | Research in Advanced Communications for Europe - another DG XIII F programme |
| RDS | Radio Data system defined by the European Broadcasting Union |
| RDS-TMC | Radio Data System Traffic Message Channel |
| ROTIR | Road Transport Informatics Review |
| RP | Road Pricing |
| RTI | Road Transport Informatics |
| SCBA | Social Cost Benefit Analysis |
| SECFO | Systems Engineering and Consensus Formation Office - a DRIVE project intended to summarise and coordinate the results of all other DRIVE projects |
| SIDEA | a Swedish road research organisation |
| TASC | Transport infrastructure assessment system developed for the European Commission |
| TCC | Traffic Control Centre |
| TRRL | Transport and Road Research Laboratory - a UK organisation |
| UTC | Urban Traffic Control |
| VDU | Visual Display Unit |
| VMS | Variable Message Sign |

## VII. References

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**Technical Report "DRIVE '89"**, *DRI 200 of April 1989.*

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## VIII. Listing of Projects

### PROJECTS ORDERED BY PROJECT NUMBER

| Proj. Number | Project Titles |
|---|---|
| V1001 | Public Transport Scheduling |
| V1002 | Short Range Microwave Links |
| V1003 | Requirements and Systems Spec. Device |
| V1004 | Vehicle Mounted Device for Monitoring Driver Status |
| V1005 | PREDICT |
| V1006 | Factors in Elderly People's Driving Abilities |
| V1007 | SOCRATES |
| V1008 | Strategies for Integrated Demand Management System (T118) |
| V1009 | Vehicle Location Systems Database |
| V1010 | PANDORA |
| V1011 | Integration of Route Guidance |
| V1012 | Road Safety Management System |
| V1013 | Comparative Evaluation of Different Radiating Cables |
| V1014 | I.M.A.U.R.O. |
| V1015 | Artificial Intelligence Systems |
| V1016 | Information System for Road User Safety Device |
| V1017 | Changes in Driver Behaviour |
| V1018 | Total Traffic Management Environment |
| V1019 | Cassiope Computer-Aided System |
| V1020 | Parking and Tidal Flow Systems |
| V1021 | European Digital Road Map |
| V1022 | Real Time Urban Traffic Control System |
| V1023 | EUROPTOPP |
| V1024 | Driver Information Systems |
| V1025 | EURONETT |
| V1026 | Integration of Computer Vision Techniques |
| V1027 | EUROFRET |
| V1028 | TUNICS |
| V1029 | Standards for RDS-TMC Throughout Europe |
| V1030 | Microwave Communications |
| V1031 | System for Vulnerable Road Users |
| V1032 | STRADA |
| V1033 | Automatic Policing Information Systems |
| V1034 | Road Information and Management Systems |
| V1035 | Motorway Traffic Flow and Control |
| V1036 | Evaluation Process for Road Informatics |
| V1037 | Definition of Standards for In-Vehicle Man Machine Interface |
| V1038 | DACAR |
| V1039 | Application of Artificial Intelligence |
| V1040 | Identification of Hazards |
| V1041 | Generic Intelligent Driver Support Systems |
| V1042 | Accident Data Collection and Analysis |

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|---|---|
| V1043 | Drive Integrated Telecommunications |
| V1044 | Freight Logistic Efforts for European Traffic |
| V1045 | Parking Management, Control and Information Systems |
| V1046 | FRIDA |
| V1047 | OD Information VS Traffic Information |
| V1048 | Advanced Control Strategies |
| V1049 | FIELD TRIALS |
| V1050 | Driving and Accident Co-ordinating |
| V1051 | Procedure for Safety Submissions |
| V1052 | ICARUS |
| V1053 | Modelling of Emissions and Consumption in Urban Areas |
| V1054 | System qnd Scenario Simulation for Testing RTI Applications |
| V1055 | AI Techniques for Traffic Control |
| V1056 | Incident Detection Congestion System |
| V1057 | Drive Systems Management |
| V1058 | Road Conditions and Weather Monitoring Systems |
| V1059 | Strategies for Road Traffic Congestion Monitoring |
| V1060 | SMART - Electronic Cards for Travel and Transport |
| V1061 | Improvement of Pedestrian Safety at Traffic Lights |
| V1062 | Multilayered Safety Objectives |
| V1063 | Inter-Vehicle Communication |
| V1064 | Universal Roadside Processor UROP |
| V1065 | SIRIUS - Sociopolitcal Implications of RTI Implementation and Use Strategies |
| V1066 | PULSAR Parking Loading Unloading Standards and Rules |
| V1067 | Implementation Aspects Concerning Planning and Legislation |
| V1068 | CHRISTINE Characteristics and Requirements of Information Systems Based on Traffic Data in an Integrated Network Environment |
| V1069 | Carpooling System Management |
| V1070 | PARIS |
| V1071 | STRADA 2 |
| V1072 | FIORE |
| V1073 | EUROTRIPP |

## IX. Organizations involved in DRIVE Projects[1)]

Belgique - Belgie - Belgium

Administration des Routes - Fonds des Routes (1032)
Administration des Routes - Division Circulation et Signalisation (1071)
BELCOTEC (1034)
BEVAC (1033, 1060)
BLIS (1014)
Centre de Recherches Routières (1014*)
Centrum voor Positieve Aanwending (C.P.A.) (1069)
DEVLON (1014)
DEVLONICS (1026)
ENI S.A. (1013)
FUNDP (1014)
Graphic Science Group (Europe) SA (1021)
Informabel (1034*)
INIEX (1013)
Langzaam Verkeer (V.Z.I.V.) (1069)
Macq Electronique (1022)
N.V. Mondia S.A. (1027)
SAIT Electronics (1028*)
Sealord Transport Consultants (1044)
SHERPA N.V. (1069*)
STRATEC S.A. (1052)
Transurb Consult (1001)
Université de Liège (1053)
Univ. Leuven (Katoliek) - KUL (1012*)

Danmark - Denmark

Road Data Laboratory (1034)
The Danish Road Directorate (1032, 1071)

Deutschland - Federal Republic of Germany

ADAC (1057, 1069, 1073*)
AEG Aktiengesellschaft (1002)
AIT Innovative DV GmbH (1016)
ANT Nachrichtentechnik GmbH (1038)
BAST (1007, 1018, 1042)
Bergische Universität-Gesamthochschule (1069)
BMW A.G. (1004, 1017, 1042, 1048, 1067)
Bundesanstalt für Strassenwesen (1032, 1067, 1071)
Daimler-Benz AG (1018, 1021*, 1036, 1044*, 1048, 1057*)
Dambach-Werke GmbH (1064)
Forschungszentrum Informatik (1039*, 1055)
Goetting KG (1038)
GSI-Datel GmbH (1044)
Hamburg Consult (1019)

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1)Project numbers are given in brackets after each organisation title.

Heusch Boesefeldt GmbH (1003, 1020*, 1024*, 1028, 1039, 1047, 1048, 1049, 1055, 1056, 1059)
Inovaplan (1023)
Institute for Transport Studies (1023)
Krone Aktiengesellschaft (1003)
LWL (1059)
Man Nutzfahrzeuge GmbH (1044)
Man Technologie GmbH (1044, 1050)
Mannesmann Kienzle GmbH (1048, 1050)
Plänerbüro Südstat (1069)
Planungsbuero Transport und Verkehr (PTV) (1044)
Rheinsch-Westfachlische Technische Hochschule Aachen (1063)
Robert Bosch GmbH (1007, 1010, 1021, 1029, 1063)
RWTH Aachen (1036, 1046)
Schuch & Co GmbH (1058)
Siemens AG (1002, 1007, 1011*, 1018, 1056, 1057)
Signalbau Huber (1018)
Standard Elektrik Lorenz AG (1038)
Steierwald Schoenharting & Part. (1003, 1020, 1048, 1056, 1067)
STRC/TFK (1044)
Technische Universität Hamburg (1003, 1020, 1024, 1047, 1048, 1056)
Technische Universität München (1036*, 1042*, 1047, 1059)
Technische Universität München (Fachgebiet Verkehrsplanung und Verkehrswesen) (1062)
Technischer Uberwachungs-Verein Bayern (1037)
TFK VTI (1016*, 1060*)
Truvelo Manufact. Deutschland (1014)
TU Berlin (1011, 1017, 1020, 1036)
TUV Rheinland (1004*, 1051*, 1053)
TZN Forschungs- und Entwicklungs-Zentrum (1058)
Universität Tuebingen (1041)
Univ. of Berlin (1025)
Univ. of Bremen (1050, 1052, 1054)
Univ. of Karlsruhe (1008, 1052)
Univ. of München (1003, 1036, 1040, 1042, 1052)
VDO Verkehrsleittechnik GmbH (1066)
Volkswagen (1038, 1048)

Ellas - Greece

Alpha S.A.I. (1016)
Antony Stathopoulos and Associates (1008, 1020)
Apostoleris (1052)
Communication and Management Systems Unit (1062)
Costas Abacoumkin and Associates (1005)
Epsilon International (1005)
Intracom S.A. (1005, 1008, 1045, 1063)
Intrasoft S.A. (1024)
National Technical University of Athens (1045*)
Organisation of Athens (1005, 1008, 1025, 1036, 1045, 1046)
PLANET S.A. (1008, 1027)

PRAXIS S.A. (1065)
Trademco Consultants (1027*)
University of Athens (1018, 1025, 1036, 1040, 1046*)
University of Thessaloniki (1019, 1027, 1035, 1047)

Espana - Spain

ASETA (1018)
Consorico de Transportes de Madrid (1001)
Control Trafico SA (CAE) (1015, 1020)
Dimetronic S.A. (1001)
Electronic Traffic S.A. (1068*)
ETRA (1011, 1026*)
Ingeniera de Sistemas Urbanos (1057)
Merit C.G.P. S.A. (1037)
Robotiker (1023)
Sainco Trafico S.A. (1068)
SECOFISA (1070*)
Sociedad Ibenica de Construcciones Electricas S.A. (1064)
Telefonica Sistemas SA (1001, 1009, 1043)
Univ. Catalunya (Politechnica) (1007, 1015, 1054*)
U.S.M. (1072*)

France

AFT (1017)
ASFA (1018)
BULL (1060)
CCETT (1029)
Centre d'Etudes Techniques de l'Equipement (Etudes Urbaines) (1061*)
Centre d'Etudes Techniques de l'Equipement Méditerranée (1061*, 1064)
CERT (1011, 1022, 1047, 1054, 1056, 1059)
CETE (1032*, 1039, 1042, 1058)
CETE Mediterranée (1019*, 1023, 1033)
Centre d'Etudes Transports Urbains (1061)
CGA HBS (1001*, 1002*, 1011, 1024, 1026)
CHS Université Lille (1002)
City of Nancy (1061)
City of Toulouse (1061)
CR2A (1015)
Crouzet (1058, 1066)
CSEE (1030)
Electronic Serge Dassault (1060, 1063*)
Europlus Conseil SARL (1071*)
Garbarini (1022, 1061)
GIE Regienov (1057, 1063)
GTM Entrepose (1022*)
Inrets (1001, 1002, 1011, 1015*, 1018, 1026, 1035*, 1037*, 1040, 1053*, 1056, 1058)
Inrets Len (1041)
Inrets Cresta (1013*)
Institut National de Recherche sur les Transports et leur sécurité (1066)
J.C.P. (1072)
Laboratoire Central des Ponts et Chaussées (1056)
LPPE - CNRS (1004)

Ministère de l'Equipement, du Logement, du Transport et de la Mer (Service d'Etudes Techniques des Routes et Autoroutes) (1071)
Peugeot SA - Renault (1004)
Regie Autonome des Transports Parisiens (1001, 1013)
Renault (1021, 1048)
Scetauroute (1035, 1059)
SEMA METRA (New Name SEMA GROUP) (1007)
SEREL (1019)
Service d'Etudes Techniques des Routes et Autoroutes (SETRA) (1067)
SETEX (1066*)
Société Anonyme de Recherche et de Conseil (1066)
Société de Transport du Grand Angoulême (1001)
SYSECA (1023, 1026, 1054, 1068)
Systèmes Informatiques Assistance Technique (1035)
Transports Urbains de Nice (1019)
TREGIE (1001, 1041, 1044)
Université de Lille USTL F.A. (1002, 1013)
VALEO (1038)
ZELT (1049*)

Ireland

NIHE (1045)
University of Dublin (College) (1033, 1041)

Italy

AISCAT (1018)
Automa Sistemi di Automazione Ind. (1039, 1055*)
Centro Studi sui Sistemi di Transporto (1057, 1067)
CNR (1058)
CSST SPA (1018, 1044, 1047*, 1048*, 1054, 1056, 1059)
ESACONTROL S.P.A. (1003, 1024)
FIAR (1009*, 1043)
Fondazione G. Marconi (1002)
Fondazione U. Bordoni (1038)
Instituto di Ricerca e Progettiazione Ecconomica e Territoriale (1065)
Italian National Research Council CNR (1036, 1055, 1059)
ITALTEL (1011)
LABEN (1050)
Marconi Italiana S.P.A. (1002)
Mizar Automazione SPA (1003*, 1011, 1048, 1057)
Politechnico di Turino (1013)
SIAP SPA (1058)

The Netherlands

Bakkenist Spits & Co. (1038*, 1070)
Bureau Goudappel Coffeng BV (1023)
Dataport GmbH (1012)
Delft University of Technology (1041)
DEVTECH (1041)
Instituut voor Toegepaste Sociale Wetenschappen (1065*)
IVA (1050)

KNMI (1058)
NEA (1044, 1072)
Netherlands Economic Institute (1027)
Nijmegen (1023)
Philips (1021)
Philips Bedrijven B.V. (1007, 1041)
Philips Components (1030)
Philips International BV (1010, 1029)
Radio Holland (1038, 1064)
Rijksuniversiteit Groningen, TRC (1033*)
Rijkwaterstaat (1018, 1035, 1065)
Stichting Wetenschappelijk Onderzoek Verkeersveiligheid (1061)
SWOV (1012)
TELE ATLAS (1021)
TNO (1051)
TNO Institute for Perception (1041)
TNO Institute of Applied Physics (1064*)
TNO Road-Vehicles Research Inst. (1058*)
Traffic Research Centre (1041*, 1042)
University of Groningen (1004, 1006, 1031, 1033)

Portugal

Adist Instituto Superior Tecnico (1066)
Empresa de Inves. E Desen. de Electronic (1020, 1030)
Junta Autonoma de Estradas (1032, 1071)

United Kingdom

Automobile Association (1010)
BBC (1029)
British Telecom (1007, 1043*)
Castle Rock Consultants (1005*, 1008*, 1015, 1025, 1029*)
Cranfield Institute of Technology (1019)
D.P. (1072)
Future Software Systems Ltd (1046)
HB Modules Limited (1031)
Husat Research Centre (1017*, 1037, 1040, 1062)
Ian Catling Consultancy (1007*, 1018*)
Imperial College (1043)
King's College, University of London (1006*)
Leeds University (1051)
Marcial Echnique and Partners (1036, 1070)
Marconi Control & Command Systems Ltd (1028, 1038)
Medical Research Council (1041)
Microsense Systems Ltd (1038, 1061)
Motor Industry Research Association (1050)
MVA Systematica (1010*, 1024, 1057)
Philips Research Laboratories (1007, 1030, 1043)
Plessey Controls Ltd (1011, 1056, 1059)
Polytechnic of Central London (1027)
Portsmouth Polytechnic (Higher Education Corporation) (1063)
Program Validation Limited (1051)
Queen Mary College (1050*)

RAC Motoring Services (1050)
SIA Ltd (1034)
SIAS Limited (1014)
Somerset County Council (1034)
Transport and Road Research Laboratory (1011, 1018, 1035, 1047, 1053, 1054, 1056*, 1059, 1061)
Transport Studies Unit (1008, 1023*, 1025*, 1065)
TRRL (1003, 1029, 1038)
University College London (1026)
University of Leeds (1011, 1015, 1031*, 1039)
University of Leeds Industrial Services (1019)
University of Newcastle upon Tyne (1030*)
University of Nottingham (1015, 1040*, 1042, 1062*)
University of Oxford (TSU) (1025)
University of Salford (1049)
University of Southampton (1011, 1052*)
West Yorkshire Hets (1031)
Wootton Jeffreys Consultants Ltd (1019, 1026, 1035, 1047, 1056, 1059*, 1068)
Yard Ltd (1016, 1037, 1041)

**European Free Trade Association countries:**

Finland

Nokia Corporation (1043)
Tech Research Centre of Finland (1036)

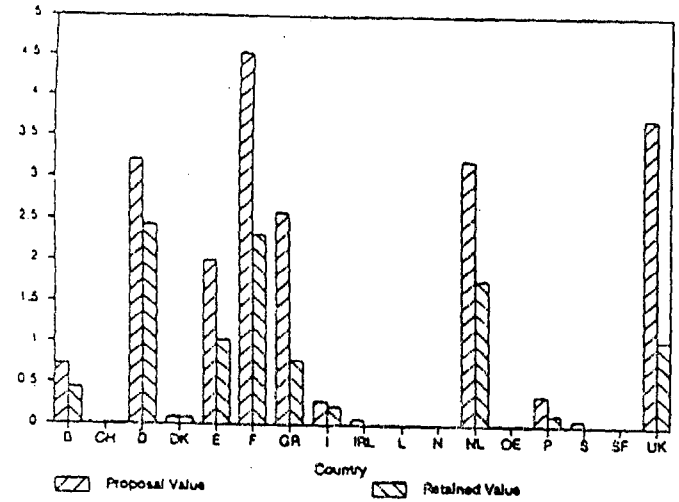
Norway

Institute of Transport Economics (1016, 1024, 1033, 1042)
Micro Design A/S (1060)
SINTEF (1052)

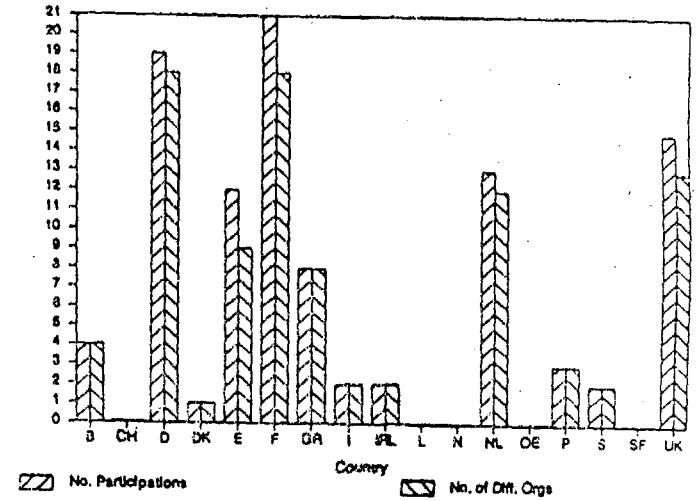
Sweden

Bilspedition AB (1027)
Conlogic AB (1065)
Institute of Technology, Lund (1062)
Institute of Transport Economics (1054)
PKAB (1030)
Royal Institute of Technology (1036, 1052)
SNRA (1018)
SRTR VTI (1017)
STRC/TFK (1016)
Swedish Institute of Microelectronics (1002)
Swedish National Road Administration (SNRA) (1067*)
Swedish Transport Research Board (1057)
Swedish Road & Traffic Research Institut (1041)
Swedish Tele Radio (1043)
TFK (1060)
University of Lund (1031, 1040)
VOLVO (1004, 1007, 1042, 1057, 1058)

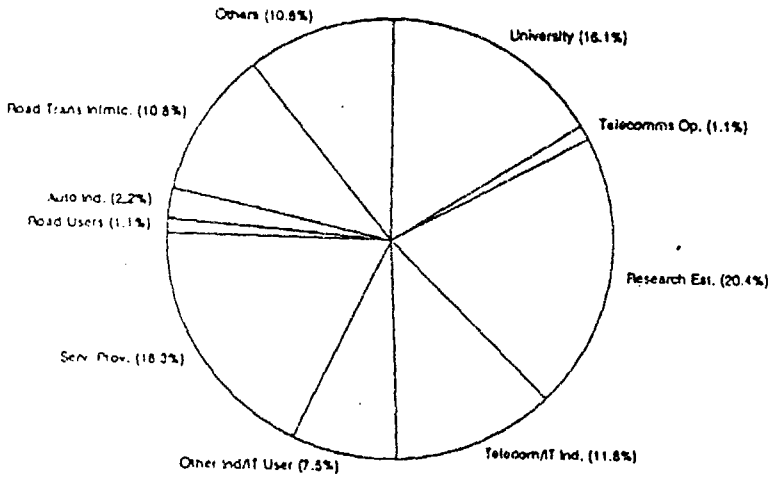
## Financial Participation (MECU)




## Country Distribution of Organisations




## Types of Organisations




## Sizes of organisations