

# INTELLIGENT TRANSPORT SYSTEMS



Results from  
the transport research programme



EUROPEAN  
COMMISSION

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### Common acronyms

<b>A-SMGCS</b>	Airport surface movement guidance and control system
<b>ATM</b>	Air traffic management
<b>CNS</b>	Communication navigation surveillance
<b>EDI</b>	Electronic data interchange
<b>ERTMS</b>	European rail traffic management system
<b>GNSS</b>	Global navigation satellite system
<b>GSM-R</b>	Global system for mobile communications - railway
<b>ITS</b>	Intelligent transport systems
<b>ITU</b>	Intermodal transport unit
<b>RIS</b>	River information services
<b>VTMIS</b>	Vessel traffic management and information services

Additional information on the transport research programme is available on the Internet. The programme's Knowledge Centre (<http://europa.eu.int/comm/transport/extra/home.html>) provides:

- structured guides to the results and projects for particular topics;
- summaries and final reports of individual projects;
- access to project web sites and other contact details.

References to some projects are included in this brochure, to help the reader access further information quickly through the Knowledge Centre.

Information on the wider transport activities of the European Union is also available on the Internet. It can be accessed through the Europa server ([http://europa.eu.int/comm/dgs/energy\\_transport/index\\_en.html](http://europa.eu.int/comm/dgs/energy_transport/index_en.html)).

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# THE NEED FOR RESEARCH



*In this brochure discover how research is helping to develop intelligent transport systems for Europe, and identify topics worth investigating further on the web.*

**D**eveloping a European transport system that is sustainable requires best use to be made of existing infrastructure. Intelligent transport systems (ITS) are vital for this. By integrating technologies for information, communications and control, they enable authorities, operators and individual travellers to make better informed and co-ordinated decisions. For example, ITS can enable more effective planning, help travellers and freight distributors to avoid delays and congestion, and increase the productivity of transport operations. In addition, ITS applications can reduce energy use, accidents and environmental damage.

ITS applications cover all modes of transport and provide a vast range of services:

- in the management of road, rail, air, waterborne and urban traffic, including: advanced information for users; traffic control; incident management; navigation, surveillance and guidance; and vehicle safety and control systems;
- in electronic payment and the enforcement of regulations;
- in the management of public transport, freight movements and other fleet applications;
- in planning and policy-making activities.

Intelligent transport systems are also a key enabler of the integration of different transport modes to provide door-to-door transport services.

The potential of ITS has encouraged the EU to make them an integral part of the Common Transport Policy<sup>1</sup>, with the aim of establishing a co-ordinated infrastructure for ITS in Europe. Therefore the transport



research programme<sup>2</sup> has contributed to the development, assessment and demonstration of ITS applications, laying the groundwork for a large deployment of ITS in the future, supported by the EU. This brochure highlights some significant results. The aim is to raise awareness of the progress that has been made, and to encourage readers to obtain further details through a web-based Knowledge Centre (<http://europa.eu.int/comm/transport/extra/home.html>).

# KEY RESULTS

*A number of projects have focused on the development of ITS in support of policy objectives. Here are some highlights.*

## Policy assessment of satellite navigation and positioning systems (Galileo)

To ensure that new satellite-based services support policy goals, requirements for the European Galileo

system have been investigated, particularly with respect to multi-modal transport.

Research has shown that Galileo will be economically beneficial for end-users in Europe. Preferred options have been identified for involving public-private partnerships in the design, building and operation of Galileo.<sup>3</sup>

## Integrated urban traffic management

Traffic management systems are a key tool in controlling congestion and pollution.

Moreover, they can be implemented in the short term. Field tests have provided evidence of the benefits of using advanced systems in an integrated way.

### City experiences<sup>4</sup>

The integration of road traffic control, public transport management and driver information systems in Turin was shown to reduce travel time by up to 20%, with a 3% modal shift to public transport. Such integration is helped by recent developments in distributed architectures for information technologies, enabling institutions to co-operate while remaining in control of their own data.



## European radio communication system (GSM-R) for train control

GSM-R is the new European standard for railway communication technology,

supporting a diversity of uses ranging from operational communications to safety-related control systems. It will make a significant contribution to the overall interoperability of European railway networks.

### Specifications for GSM-R<sup>5</sup>

Research has provided the specifications for the GSM-R system. These now form a core part of the technical specifications for the European rail traffic management

system (ERTMS). GSM-R has great potential in providing new value-added services for the customer as well as supporting maintenance and operations, thereby enabling the rail sector to compete more effectively.



## Operational concept and validation platform for the European air traffic management (ATM) system

Major research has been directed towards preparations for the European ATM system. This has included integrating systems, technologies and operational approaches, preparing validation activities, and evaluating improvements in capacity, safety and costs.



### Enhancing the European ATM system<sup>6</sup>

Research has helped to define an operational concept compliant with Eurocontrol's strategic plans. This includes the functions and services that will support gate-to-gate planning.

In addition, a methodology has been provided for future large-scale demonstrations contributing to the validation of the European ATM system.

## Creating e-markets in intermodal freight transport

To make intermodal transport more attractive, seamless information exchange is needed between operators and to/from

their customers. This requires the development of standardised solutions for electronic data interchange (EDI) and other methods of information transfer.

### Smooth information systems<sup>7</sup>

Co-operative information systems with Internet-based communication interfaces have been successfully piloted. These provide services such as booking and shipment status information. A conceptual

information model has been devised, creating the basis for integrated information systems involving all actors along the transport chain, from consignor to consignee.



## Efficient short sea shipping and inland waterway traffic management

Vessel traffic management and information services (VTMIS) and river information

services (RIS) are the European ITS concepts that will support maritime and inland waterway traffic and the associated multi-modal transport logistics.

### Improving management systems<sup>8</sup>

A framework has been provided to extend VTMIS and RIS from traffic management to the provision of information for the optimal control of cargo flows and infrastructure. Ways of improving VTMIS have been identified,

with the aim of providing pan-European methods for exchanging information between existing systems. The functions of the RIS concept have been detailed and services including voyage, terminal and lock planning have been demonstrated.

# AREAS OF RESEARCH

- R**esearch into ITS has had two main concerns:
- investigating the merits of introducing new technologies, and
  - identifying and piloting developments that are necessary for ITS implementation and regulation.

The main research lines are listed below.

## **Infrastructure and common services**

Assessing new technologies against policy criteria, particularly satellite navigation and positioning systems (Galileo).

## **Information systems for European transport**

Developing the means of establishing databases and information systems to support planning and policy-making at the EU level.

## **Intermodality for travellers**

Demonstrating and evaluating urban traffic management systems, urban road pricing, and telematics for transport in rural areas.

## **Road transport**

Identifying the potential to improve road safety and efficient traffic management using advanced telematics, such as traffic control systems and variable message signs.

## **Rail transport**

Specifying and testing the control and telecommunications systems of the European rail traffic management system (ERTMS), and evaluating the use of advanced technologies in rail freight.

## **Air transport**

Specifying and evaluating aspects of the European air traffic management system, defining the validation process, and assisting the development of airport surface movement guidance and control systems (A-SMGCS).

## **Intermodality for freight transport**

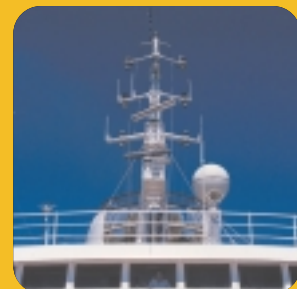
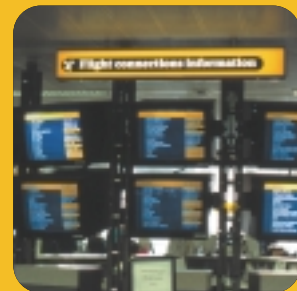
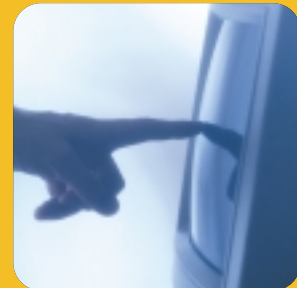
Developing information systems for the intermodal transport chain, terminal operations and urban freight distribution.

## **Maritime transport and inland waterways**

Developing and demonstrating advanced solutions for river information services, vessel traffic management and integrated ship control centres.

## **Managing ITS innovation**

Assessing new technologies for their effects on the working environment, institutional responsibilities and training needs.



# INFRASTRUCTURE AND COMMON SERVICES

## Policy assessment of integrated technologies

**T**he policy-driven introduction of new technologies to the transport sector requires careful evaluation

against policy goals. The transport research programme has done this for the integration of information, communication and navigation technologies in transport, in particular addressing the European satellite navigation and positioning system Galileo.

### Galileo<sup>3</sup>

Preferred options have been identified for involving public-private partnerships in the design, building and operation of Galileo. Preferences established are for joint ventures for the design phase, shared concession for the building phase and private concession for the operation phase.

The main policy requirements have been identified as:

- an early decision on the final architecture of Galileo and on the intention to incorporate global navigation satellite system (GNSS) and Satcom into Galileo;
- the creation of an overarching European Satellite Information Service Authority;
- a commitment not to allow the system to be controlled by security, political or defence interests.

### Comprehensive payment systems<sup>9</sup>

Research has shown the following services to have a strong potential impact on policy goals: road pricing, infrastructure tolling, public transport ticketing, parking payment, road usage payment by heavy goods vehicles, and paying for transport information.

Suggested priorities for EU policy include:

- keeping focused on the introduction of electronic licence plates;
- measures to secure compatibility between electronic payment systems;
- agreeing a strategy for implementing heavy goods vehicle fee payment systems in Europe;
- standardisation of contact-free smart cards;
- supporting the deployment of secure remote-user identification.



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### Safety approval for global navigation satellite systems (GNSS)<sup>10</sup>

Studies have provided a methodology for developing safety cases for GNSS applications, together with three manuals dedicated to civil aviation,

waterborne transport and land transport. Application of the methodology to the Galileo programme highlighted the need to establish a safety management system, an independent safety assessment, a safety plan and a contingency plan.

# INFORMATION SYSTEMS FOR EUROPEAN TRANSPORT

**I**nformation systems on transport supply and demand are essential to help policy-makers in planning for the future, especially at the level of European networks. The existing data, data

structures and models in use across Europe are generally inconsistent, incompatible and proprietary. The transport research programme has therefore funded several activities to develop a transport policy support system.

## European transport policy information system<sup>11</sup>



A general architecture for a European transport policy information system (ETIS) has been proposed together with a process for its development. The recommendation is for a network of interconnected co-operating systems, allowing access to various databases across Europe. This kind of open and modular system architecture will enable continuous upgrading as new databases and models become available. The research work has provided software to support the connection process, a proposed standard format for data exchange, and applications to simplify the interface with end users.

## Monitoring infrastructure<sup>12</sup>

The feasibility of developing a network of centres to monitor the application of European transport policies, particularly large infrastructure projects, has been

demonstrated. A prototype has been developed, using the web to provide user-friendly access to harmonised information coming from a pilot group of monitoring centres.

## Travel survey data<sup>13</sup>

Modern information technologies provide an alternative method of conducting travel surveys and assembling trip statistics in comparison with traditional questionnaire methods. For long-distance trips, research has shown that new

technologies can significantly improve the quality of travel data surveys. The use of portable electronic travel diaries and web-based tools are expected to expand greatly as the generic technologies improve.



# INTERMODALITY FOR TRAVELLERS

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lectronic tools play an increasingly important role in managing road traffic, charging for transport and

providing flexible transport services, thus promoting a switch to more sustainable modes such as collective transport.

## Urban traffic management systems<sup>14</sup>

Various combinations of traffic management measures have been evaluated in field trials or simulations, such as bus priority at traffic lights and automatic vehicle location. Guidelines were formulated on the operation of fully integrated traffic management systems, combining traffic control, public transport management and driver information. Fully integrated systems proved promising, with travel time reductions of up to 20% being measured in Turin.

Research has also provided a new methodology for optimising the timing of traffic signals, taking into account travellers' responses such as re-routing.

Tests in York showed a 25% increase in peak-hour patronage of park & ride buses that could be attributed to the new timings.



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## Urban road pricing<sup>15</sup>

Road pricing schemes have been tested on two trial corridors, in Trondheim and in Bristol. Both were equipped with roadside toll stations and on-board transponders. The Bristol corridor demonstrated the benefits of designing road-pricing schemes

as part of a multi-modal integrated payment scheme, with a shift of 15-20% to public transport. One conclusion is that pricing technologies should be able to communicate service consumption to travellers on a regular and automated basis, as this will influence their travel behaviour.

## Transport services in rural areas<sup>16</sup>

Public transport in rural areas suffers from low levels of patronage, and therefore has to be flexible to compete. Research highlighted the potential of using the Internet and mobile phones in the operation of both regular and

on-demand services. Combining passenger and goods transport, for example by integrating the booking of passenger trips with the scheduling of goods deliveries, also looks promising.

# ROAD TRANSPORT

**S**peed is a major factor in road safety – lower and more uniform speeds would reduce the overall number of accidents and mitigate their consequences. Therefore research has looked at methods of speed management. Variable

message signs have been studied as they are a crucial element in traffic information provision. Micro-simulation of traffic flows has also been targeted, since this can help in optimising traffic management and driver information systems.

## Managing traffic speeds<sup>17</sup>

Guidelines have been developed covering the use of speed management measures. Advanced telematics solutions include informative/warning systems, recording systems to register speed, and automated speed control. Adaptive in-vehicle speed limiters were tested in real traffic: they proved the most effective in reducing speed, while informative systems were more acceptable to drivers. Adaptive cruise control was found to raise a policy dilemma over the setting of vehicle

headway (distance between vehicles), since the low headway that would avoid a reduction in road capacity may violate the recommended level for safe driving.



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## Variable message signs (VMS) for the trans-European road network<sup>18</sup>

Guidelines have been provided for the use of VMS for control, advice, warning and information as part of the EU

strategy for development of the trans-European road network. They include practical techniques for organising VMS operations, strategies, procedures and messages.

## Simulation models for dynamic traffic management<sup>19</sup>



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Improved micro-simulation tools have been developed to support the assessment of road traffic schemes and the optimisation of urban traffic control in real time. Research has also produced a best-practice manual for the selection and use of micro-simulation models. In the future, the use of distributed computing is expected to speed up the simulations further, making them a useful tool across realistic road networks.

# RAIL TRANSPORT

## European rail traffic management system (ERTMS)

**T**he deployment of harmonised systems for train control and communication, and the creation of trans-European traffic management facilities, are vital for the integration of the rail network.



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### European radio communication system for train control (GSM-R)<sup>5</sup>

The transport research programme helped to develop an integrated radio system based on the GSM standard to support ERTMS applications. Validation

was carried out at three trial sites, and implementation of GSM-R is now underway in a number of European countries.

### ERTMS architecture<sup>20</sup>

Research to specify system-level architecture for ERTMS, applicable to international railway corridors, has outlined the evolutionary path to

a comprehensive traffic management system. This is based on the definition of options for information management, system interfaces and the communications infrastructure.

## Rail freight services

Intelligent tools on board rail freight trains, train-ground information exchange and

tools for fleet and infrastructure management should significantly improve the costs and quality of freight transport.

### Fleet and infrastructure management for rail freight transport<sup>21</sup>



Concepts and strategies for intelligent freight trains have been developed, based on automatic train identification,

electronic braking and train integrity checking. Additional technologies would provide information, automation, diagnosis and cargo monitoring functions. The major industrial partners and railway operators involved in this research have already decided to implement the base system. Studies also established the overall specifications for freight information in the railway environment, and validated a subset of the information system in a demonstrator.

# AIR TRANSPORT

## European air traffic management (ATM) system



**T**he predicted growth in air traffic calls for more efficient use of existing capacity in the air transport system. This is a key goal of the planned European ATM system. The development of

ATM now requires a robust validation process, and this has been the focus of substantial research.

### Operational concept of the European ATM system<sup>22</sup>

An operational concept has been devised for the European ATM system that is achievable in the medium term (between 2005 and 2010). The viability of the

concept has been confirmed in technical, operational and economic assessments. Critical functions and operational services were identified in the areas of flight planning, terminal area sequencing, airport operations management and control, and gate-to-gate aircraft flight management.

### European ATM system validation environment and methodologies<sup>23</sup>

A validation platform for ATM has been developed and presented to the aviation community. The platform will be used to validate candidate ATM concepts and functions, as well as the most promising

candidate technologies for communication, navigation and surveillance (CNS). Proposals have been made for actions that would increase synergy across validation-related projects.

## Airport movement management

The increasing traffic at airports coupled with the constraints on constructing new airports or runways calls for more efficient use of existing ground infrastructure.

The advanced surface movement guidance and control system (A-SMGCS) concept has been developed to enable integrated management of airport ground movements. Research has demonstrated and evaluated prototype solutions.

### Tests for airport surface movement guidance and control (A-SMGCS)<sup>24</sup>

A large-scale demonstrator has been implemented at Cologne–Bonn airport. Based on this experience, basic guidelines have been provided for future projects when making the step from

demonstration to prototype systems. Flight planning was highlighted as a specific issue for gate-to-gate co-ordination of air traffic, requiring agreement with air traffic controllers on their future responsibilities. Transition training will be required for the introduction of A-SMGCS.

# INTERMODALITY FOR FREIGHT TRANSPORT

## Smooth information exchange

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ince many different parties are involved in intermodal transport chains, electronic data interchange

and telecommunications are essential to facilitate and integrate operations. Pilot systems have been developed as a first step towards the creation of a unified and standardised system, aimed at providing open access to information services.

### Towards electronic freight market places<sup>25</sup>

Research has demonstrated the feasibility of e-business practices in the intermodal market. Various systems, including Internet-based solutions, have been successfully piloted. These support the pre-contract stage of intermodal transport and provide clients with status

information on their shipments. Low-cost solutions have been tested for small and medium-sized enterprises. Research has also produced a conceptual information model covering the information needs of all actors along the entire transport chain.

### Seamless tracking and tracing<sup>26</sup>

Manual monitoring of the movement of goods along a transport chain is time-consuming owing to the differences in methods used by the various parties. In response, a distributed system has

been tested for the tracing of communications chains and tracking of general cargo. The lack of a low-cost and robust solution for read/write tags remains a significant obstacle to investment for many companies.

## Intermodal terminal operations

Freight transshipment at nodal points adds costs and transport time to the door-to-door movement of freight, and represents one of the main bottlenecks in using

intermodal transport. The efficiency of the transfer between ships, barges and land transport modes is particularly important if short-sea shipping and inland waterways are to be integrated into European transport networks.

### Automated freight handling<sup>27</sup>

Research has evaluated modular pilot plant for automated handling of freight, produced prototypes of new wagons for efficient handling of intermodal transport units (ITUs), and assessed automated location systems for ITUs. A new concept has been developed for

the port/ship interface, including a cargo handling system at the terminal and the associated vessel design. The concept potentially has lower investment requirements and higher efficiency than other port/ship transshipment systems.



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# MARITIME TRANSPORT AND INLAND WATERWAYS

## Traffic management and information systems

**T**raditional vessel traffic services (VTS) for both maritime and inland navigation have focused on traffic management, with an emphasis on safe navigation. More recently, vessel traffic management and information services (VTMIS) and river information services (RIS) have been developed as the ITS concepts



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for efficient and safe navigation at a European level.

### Vessel traffic management and information services (VTMIS)<sup>28</sup>

Interconnection of existing information systems has been demonstrated at a number of test sites, with the aim of establishing methods for information exchange within a Europe-wide VTMIS network. Successful value-added services have been demonstrated based on technologies such as automatic identification systems and electronic chart and display information services. Benefits include:

- better dissemination of traffic information for operations management;

- access to vessel data, and access to cargo data when required for safety reasons;
- improved contingency planning and access to marine pollution information.

A communications standard has been developed and tested enabling the exchange of traffic and environmental data between VTS centres and systems that use different technologies.

### River information services (RIS)<sup>29</sup>

Specifications have been defined to manage the information flows between a vessel and the shore or another vessel. From this, an architecture was developed for information flows aboard a vessel, providing the skipper with the applications needed to exploit RIS.

Open standards have been developed for information exchange between the actors in inland shipping, including transporters, terminals and lock operators. These have been demonstrated under operational conditions to prove the benefits of RIS to potential users.

## Safe and efficient ship operations

New technologies are vital for increased safety and efficiency at sea. Research has laid the foundation for new European

standards for the design of both ship control centres and integrated ship control systems.<sup>30</sup> The development of a prototype maritime black box has been another achievement.

# MANAGING ITS INNOVATION

## Human and organisational factors

**S**uccessful technological innovation requires organisational implications to be assessed and strategies developed to deal with potential problems. The transport research programme has made recommendations on the institutional framework for the promotion of new technologies, and has studied



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effects on working cultures, management structures and training.

### Creating the environment for ITS development<sup>31</sup>

Research has highlighted the need for a co-ordinated approach at European level to harmonise the pace of technological innovation with the associated regulatory process. Recommendations have been made on the distribution of responsibilities among parties, for instance concerning failure investigation.

Policy actions that would accelerate the market take-up of ITS include pricing reform, financial incentives in the early stages of ITS markets' development, dissemination, pilot projects, and measures to stimulate co-operation between operators.

### Harmonising maritime education<sup>32</sup>

Guidance has been produced on the upgrading of education and training in the maritime sector, to help people cope with the demands of new

technologies and make best use of simulator-based training. The research will support the implementation of the international convention on standards of training, certification and watch-keeping for seafarers (STCW'95).

## Transport for the future

New technologies currently under development will make it possible to

deploy new transport concepts in the future. These have to be assessed against policy goals.

### New transport technologies<sup>33</sup>

Advanced telematics have attracted much attention for relieving congestion and safety problems on the roads. Automatic incident detection with variable speed limits, aimed at reducing the potential for secondary incidents on

the network, was found to be the most promising option in the short term. Adaptive cruise control is unlikely to have a significant impact on network efficiency in the near future, until it reaches a substantial level of market penetration.

# CURRENT DEVELOPMENTS IN TRANSPORT RESEARCH

*This section identifies some of the current research in the field of ITS. Further details are available from the Links section of the web-based Knowledge Centre.*

**T**he emphasis in the development of ITS is to use technologies to integrate the operation and management of transport and logistic systems across organisations and modes. ITS should thus

enable the long-term vision of a European transport system where seamless travel is possible from door to door for people and goods.

## **Priorities and current research lines**

*Strategic information and evaluation systems* – developing a European decision-support and information system in the field of transport strategies.

*Satellite navigation and positioning systems (Galileo)* – providing support for policy decisions on international co-operation, and demonstrating systems in a range of applications.

*Safety, security and human factors* – devising rules and procedures for new systems and

for interaction with human beings; promoting security in public transport and intermodal freight operations; supporting training and education needs.

*Advanced traffic management systems* – further development of VTMS, RIS, ERTMS, the European ATM system and road traffic information and management systems.

*Transport and mobility services* – demonstrating door-to-door passenger and freight services using integrated information, reservation and payment systems and advanced transfer technologies.

## **Standardisation activity for Galileo<sup>34</sup>**

The implementation of satellite navigation and positioning systems (Galileo) is a key part of the EU strategy for the intelligent organisation of multi-modal transport in the future. Standardisation

activities are an essential precursor to the viability of new markets for Galileo services. Research is underway to deliver a set of standards ready for approval by relevant bodies by 2003.

## **Guidelines for deployment of advanced driver assistance systems<sup>35</sup>**

Driver assistance systems are approaching market entry in a number of applications. However it is not clear how they will

impact on road transport, in particular on safety. Research is underway to assess the effects of a range of systems, based on test site demonstrations. The work will support the development of road safety policy.





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### Improving quality in shipping<sup>36</sup>

Improving the quality of the European shipping fleet depends not only on new vessels being built but also on the upgrading of existing equipment. One project will provide a methodology for retrofitting of modern control systems to the existing fleet, based on the ATOMOS standard for integrated ship control, and will demonstrate this with a full-scale retrofit to a trial vessel.

### Means to enhance security in public transport<sup>37</sup>

A perceived lack of security hurts the image of public transport, while aggression towards staff has led operators to question the provision of services at certain places or times. Therefore

cost-effective solutions for improving actual and perceived security will be developed and demonstrated, including technological tools such as monitoring and automated incident detection.

### Advanced solutions for the interoperability of European railways<sup>38</sup>

Further developments of ERTMS are seeking to establish a supervisory management facility along major European corridors This would be built

upon the different traffic management systems and an associated information infrastructure for customer door-to-door services. Research will define the specifications for such a system, while a thematic network will seek to resolve interoperability issues for rail freight services.

### Validation of airport surface movement guidance and control<sup>39</sup>

Work aimed at the early implementation of the A-SMGCS concept will use trials to assess specific A-SMGCS functions and their safety and environmental impacts. These trials will be carried out at two mid-size airports. The results will be delivered to standardisation groups.



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### Open framework for road traffic simulation<sup>40</sup>

Dynamic traffic models provide a less expensive tool than on-street trials to assess the effects of different policy measures on road traffic. Research is underway to develop micro-simulators with user-friendly dynamic visualisation

to help communicate the results more effectively. The work will provide an open framework allowing interconnection with other systems such as urban traffic control and geographic information systems.

### Integrated travel and traffic information services<sup>41</sup>

An increasing amount of data is being presented to drivers. This is not always particularly useful, and sometimes may even be detrimental to safety. Research is looking at the needs of drivers in terms of content, presentation, availability, reliability, timing and hierarchy of the information provided. The work will develop new methods of information provision and presentation and will provide guidelines for traffic information and management systems.



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### Intermodal freight information services<sup>42</sup>

A thematic network is seeking to define a basic concept for a common information exchange layer between freight information and traffic management systems, leading to recommendations for new value-added services. Another project is extending the successful pilot of an Internet-based information distribution system for combined transport to a wider range of corridors and types of intermodal transport chain.

### New technologies for intermodal freight terminals<sup>43</sup>

Terminal optimisation is a major topic of research. One important aspect is the development and integration of new technologies, where research is focusing

on innovative transshipment techniques and the consequences for interoperability of other transport equipment.

### Integrating waterborne transport into intermodal chains<sup>44</sup>

To support market transformation, innovative solutions for managing integrated logistic chains need to be included in large-scale demonstrations. Therefore one project will support the integration of ports into intermodal

transport chains by offering new tools to ease the management of data. Another project will demonstrate web-based client applications and advanced EDI solutions in different supply chains for increasing the competitiveness of inland navigation within intermodal door-to-door transport operations.

## References

Further information on the following projects can be obtained from the web-based Knowledge Centre.

Other key documents referenced in the brochure are available on the DG Energy and Transport web site ([http://europa.eu.int/comm/dgs/energy\\_transport/index\\_en.html](http://europa.eu.int/comm/dgs/energy_transport/index_en.html)).

1. *White Paper "European transport policy for 2010: time to decide", COM(2001)370*
2. *The transport research programme is part of the fourth framework programme for Community activities in the field of research, technological development and demonstration for the period 1994 to 1998*
3. *TRANSINPOL and VAST projects*
4. *DIRECT and INCOME projects*
5. *MORANE project*
6. *AVENUE and TORCH projects*
7. *CESAR and INFOLOG projects*
8. *INDRIS and VTMS-NET projects*
9. *TRANSINPOL project*
10. *MUSSST project*
11. *BRIDGES, INFOTAT and MESUDEMO projects*
12. *ASSEMBLING project*
13. *TEST project*
14. *DIRECT, INCOME and MUSIC projects*
15. *CONCERT-P project*
16. *VIRGIL project*
17. *DIATS and MASTER projects*
18. *TROPIC project*
19. *HIPERTRANS and SMARTTEST projects*
20. *OPTIRAILS project*
21. *FIRE and INTELRET projects*
22. *TORCH project*
23. *AVENUE and CAVA projects*
24. *DEFAMM project*
25. *CESAR, INFOLOG, INTRARTIP and PROSIT projects*
26. *OCTOPUS project*
27. *IMPULSE, IPSI and PRECISE-IT projects*
28. *MOVIT and VTMS-NET projects*
29. *INCARNATION, INDRIS and RINAC projects*
30. *ATOMOS II, DISC and DISC II projects*
31. *HINT and MINIMISE projects*
32. *MASSTER project*
33. *DIATS project*
34. *SAGA project*
35. *ADVISORS project*
36. *ATOMOS IV project*
37. *PRISMATICA project*
38. *OPTIRAILS II project and RAILSERV network*
39. *BETA project*
40. *OSSA project*
41. *TRAVELGUIDE project*
42. *CESAR II project and THEMIS network*
43. *EUTP II network, ITIP project*
44. *ALSO DANUBE and IP projects*

The programme's Knowledge Centre is available at:

<http://europa.eu.int/comm/transport/extra/home.html>

It provides:

- structured guides to the results and projects for particular topics;
- summaries and final reports of individual projects;
- access to project web sites and other contact details.

Brochures on results from the transport research programme

are available for:

1. Sustainable mobility
2. Clean urban transport
3. European transport networks
4. Single European sky
5. Maritime safety
6. Freight intermodality
7. Getting prices right
8. Road safety
9. Intelligent transport systems



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