Final Report for publication

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Foreword

Transport policy makers show an increasing interest for the integration of information, communication and navigation technologies in transport. This interest is mainly due to the potential of these technologies to support the execution of the transport policy and to contribute to strategic policy objectives. This is also the case at the European level, reason why the European Commission has initiated, within the Fourth Framework Programme, a strategic research aiming at identifying the policy requirements for the integration of information, communication and navigation technologies in transport. This research has been carried out within a project called TRANSINPOL. The present report is the final report of this project.

The scope of TRANSINPOL is broad and includes many transport modes, functions of transport services, functions of information, communication and navigation services, both for passenger and freight transport, specific to the circumstances in all Member States and related to many different areas of the market and policy areas. The challenge of TRANSINPOL was firstly to get a sufficient insight into these numerous aspects and secondly to present this insight in a way enabling to share it with the numerous stakeholders in the field, in particular those who establish transport policy at the European level. How to deal with such a question, giving sufficient added value to the recipients of our work and not contributing to a further confusion, was one of the major tasks carried out in this project.

Although accessible to all, this report is mainly oriented towards policy makers and aims at facilitating the formulation of policy for the integration of above mentioned technologies in transport. The report describes the components and mechanisms of the policy making process and identifies the most pressing issues related to the integration of information, communication and navigation technologies in transport.

Abstract

TRANSINPOL is a strategic transport research project which addresses the integration of information, communication and navigation technologies in transport.

Through the development and deployment of new systems and services, these technologies have the potential to support the objective of the Common Transport Policy (CTP) by contributing significantly to a safer, more efficient and sustainable transport system. However, in order to ensure maximum benefit from the integration of the above mentioned technologies, it is necessary to identify and to describe the most pressing issues that policy makers need to address as well as the possible options available to them.

The main objective of TRANSINPOL is to provide policy makers with the information they need to develop, within the framework of the CTP, a policy for the integration of information, communication and navigation technologies in the transport sector. During the project, the information needed by policy makers has been designated by the generic term **"*policy requirements*"**.

During the project, two different approaches have been followed for the formulation of policy requirements: a functional approach and an operational approach.

In the functional approach, integration is seen as an instrument that policy makers can use to achieve the objectives of the Common Transport Policy. This approach led to the identification of six main policy functions and to the formulation of the associated needs for policy intervention, or "*functional policy requirements*".

In the operational approach, the research focussed on the barriers likely to hinder the integration process and to affect the desired impacts of the integration in an unacceptable way. This approach finally resulted into a selection of the most frequently encountered barriers and into the formulation of the associated needs for policy intervention, or "*operational policy requirements*".

As expected, it appeared that the process leading to the formulation of policy requirements was very complex due to the number and diversity of aspects to be taken into account. Early in the project, the need for a more global and structured approach became rapidly evident. This has led to the elaboration of a **"framework for policy assessment"**, or in other words of a "tool" enabling to facilitate the policy makers' task. The framework for policy assessment is a description of concepts and relationships in transport, in information, communication and navigation technologies, in integration issues, including the explanation for changes, i.e. the dynamics. It gives a scheme how to assess policy options. Although actual policy-making is not a fully rational process, such a scheme intends to be a model to support the design of policy action plans.

In conclusion, TRANSINPOL must be considered as a starting point to formulate transport policies. Although the study was oriented first of all towards policy making in transport at the European level, the major issues and the approach given are also relevant on other administrative scales, e.g. Member States, regions and urban areas, where integration of information, communication and navigation technologies in transport plays a role.

Executive summary

Through the development and deployment in transport of new systems and services, information, communication and navigation technologies have the potential to contribute to the achievement of the objectives of the Common Transport Policy. However, ensuring maximum benefit from the integration of these technologies in transport requires to identify and to describe the most pressing issues that policy makers should address, i.e. to identify what are the needs for policy intervention, and to identify the possible policy options.

TRANSINPOL is a strategic transport research project funded by the European Commission DG Transport and aiming at identifying the needs and options mentioned above. In the framework of the project, these needs and options have been designated by the generic term "**policy requirements**".

Given the complexity of the process leading to the formulation of policy requirements, the project also aimed at describing in a clear and structured way:

- the elements likely to have an impact on the integration of new technologies in transport,
- the relations between these elements,
- the different steps leading to the formulation of policy requirements.

The description of the elements, relations and steps mentioned above has been designated by the generic term **"framework for policy assessment"**.

The present document is the final report of TRANSINPOL. It provides successively a description of the framework for policy assessment, a synthesis of the policy requirements formulated during the project and a more detailed description of the policy requirements obtained in the different domains covered (information and communication services, comprehensive payment systems, satellite communication and navigation systems, legal issues and socio-economic issues).

Framework for policy assessment

The process leading to the formulation of policy requirements is very complex due to the number and diversity of aspects to take into account. During the project, the need for a more global and structured approach became rapidly evident. This has led to the elaboration of the framework for policy assessment, or in other words of a "tool" enabling to facilitate the policy makers' task. The three main components which constitute the framework for policy assessment are presented in this report:

- *policy assessment elements*, corresponding to elements that policy makers have to take into account when defining policies for the integration of information, communication and navigation technologies in transport. These elements are the transport world, the Common Transport policy, the information, communication and navigation technologies, the generic transport telematic services[1] and the integration process.

[1] groups of telematic services characterised by the same transport functionality

- *policy assessment relations*, describing the relationships between the five elements mentioned above and the way they interact (e.g. needs for new telematic services in transport, opportunities offered by the technology to develop new services, presence in the transport world of barriers to the integration,…).
- *policy assessment steps*, identifying in a logical way the different steps constituting the policy assessment process, from the identification of the needs of both the transport world and the Common Transport Policy to the formulation of policy requirements.

Synthesis of policy requirements

Two different approaches can be followed to identify and formulate policy requirements: a functional approach, driven by the impacts that the integration has on transport, and an operational approach, driven by the obstacles that the integration process meets. These two approaches lead naturally to two different types of policy requirements:

- functional policy requirements: needs for policy intervention to ensure that the impacts of the integration contribute to the achievement of the CTP objectives.
- operational policy requirements: needs for policy intervention directly related to the necessity to overcome the barriers that may hinder the integration process.

Functional approach

The integration of information, communication and navigation technologies in transport leads to new systems and services which may change transport or the transport system in various ways. Therefore, from a CTP perspective, integration has a real policy function and can be seen like an instrument that policy makers can use to achieve CTP objectives.

This report describes six policy functions that the integration has the potential to fulfil ("*to change the transport demand*", "*to optimise the Trans European infrastructure services*", "*to improve the efficiency of transport*", "*to improve transport safety*", "*to facilitate the integration of transport systems*" and "*to facilitate fair and efficient pricing*") and identifies the associated needs for policy intervention (functional policy requirements).

Operational approach

Identifying functional policy requirements is a crucial and necessary step but it does not totally guarantee that at the end, the expected impacts of the integration become a reality. Once the integration process has started, many kinds of barriers can hinder the integration process and affect the desired impacts of the integration in an unacceptable way. This report identifies the domains in which barriers can be found (technology, legislation,…) and indicates the main barriers encountered in each domain (insufficient infrastructure, absence of commercial interest,…).

On the basis of this list of barriers, the report presents a selection of seven frequently encountered barriers, in transport in general but also in the specific areas of comprehensive payment systems and of GNSS (lack of standards and harmonisation, absence of high level architecture, insufficient user-oriented approach, high user costs, insufficient information exchange, absence of an information and communication architecture, difference between legislations) and identifies the associated needs for policy intervention (operational policy requirements).

Information and communication services

The use of the framework for policy assessment to obtain the policy requirements for the integration of information and communication services in transport has led to the identification of twelve areas for policy attention addressing the major topics that need to be considered by policy makers. This report describes in detail these areas. In particular, it addresses systematically:

- the major trends in transport and in information and communication technologies which may lead to opportunities to contribute to the objectives of the CTP,
- the reasons which make that the area is relevant from the point of view of European policy and in particular from the point of view of the CTP,
- the barriers hindering integration and the possible policy options.

The identification and description of each area for policy attention has led to the formulation of policy requirements. This report provides a detailed description of these policy requirements. In summary, the following needs for policy intervention have been found:

- need to explore and monitor the consequences on transport demand of the integration of information and communication technologies in the society
- need to establish a framework for the changing of mobility behaviour in line with the objectives of the CTP
- need to integrate information services between transport modes and transport operators
- need to promote efficient data exchange and data sharing between transport information services
- need to make the information and communication technologies supplier base to transport more responsive and more efficient
- need to define information and communication technologies-related transport safety requirements
- need to promote a better use of infrastructure through traffic management for all modes
- need to promote user-orientation through commercial services and well defined user-interfaces
- need to support the definition of high-level architectures (transport telematic system functionality)
- need to support harmonisation and standardisation (interoperability of technical transport telematic systems, messages and terminology)
- need to promote technology transfer between regions and define the major European nodes and links
- need to stimulate the implementation of policies and the timing of policy actions.

The policy requirements mentioned above aim at ensuring that the collective transport and societal needs that can not be fulfilled by the various actors in transport and in the information and communication technology industry are even so addressed.

Comprehensive payment systems

The term Comprehensive payment systems used throughout the report is defined as "*Information and Communication Technologies-based payment systems covering several geographical areas, several transport modes or several service sectors*". The primary function is to enable the user of a service to pay for this service, using electronic means.

The report focuses on four areas where the prospects of contributing positively to the fulfilment of the objectives of CTP are the largest ones: road usage, passenger services (mainly bus/train, short distance rail and ferries), car parking and transport information services. In these domains, eleven payment services have been identified and clustered into *primary electronic payment services* directly used by end-users and *supportive electronic payment services* that merely ensure the necessary infrastructure being available to the primary electronic payment services.

Analysing the reasons for the slow implementation of the eleven payment services has led to the identification of numerous barriers. By grouping the barriers and by giving them priorities in relation to their ability to hinder integration, eight important groups of barriers have been identified (lack of standardisation of on-board units in vehicles, lack of knowledge of the impact of road pricing…). Then, the policy options likely to overcome the identified barriers have been studied, which has led to the formulation of policy requirements.

This report provides a detailed description of the electronic payment services, of the barriers hindering their development and deployment, and of the associated policy requirements. In summary, the following needs for policy intervention have been found:

- need to support the development of road pricing technology in order to secure enhancement and maturation,
- need to investigate on the long term effects of road pricing and tolling, especially on localisation issues,
- need to keep strong focus on the introduction of the electronic license plates,
- need to support common platform development in order to secure compatibility between different electronic purse solutions and inter-operability between operators,
- need to develop a strategy regarding the different technological implementation of fees for Heavy Good Vehicles in Europe,
- need to support the standardisation of contact-free smart cards,
- need to promote the hybrid electronic payment cards development,
- need to support the standardisation and harmonisation of better and cheaper secure electronic payment services in the transport sector,
- need to support the deployment of secure remote user identification.

Satellite communication and navigation systems

The starting point for this part of the report is the Common Transport Policy, the decisions already taken by the Commission to develop the Proposed Baseline European

Radionavigation Plan into an actual plan within the next two years and the decision to continue with the actions leading to the implementation of Galileo[2].

To consider how these existing and proposed satellite technologies could be integrated with other Information Society technologies and to identify the policy issues that would need to be addressed to achieve the optimum integrations for the benefit of European transport are two of the major issues addressed in this report.

The work carried out during the project and described in this report shows that:

- a major potential exists to deliver, through an integrated approach, significant and desirable safety and operational benefits for all modes of European transport
- a major wealth creating industry is waiting to be born if the decision is taken to invest in this technology and develop the relevant policies to ensure a controlled and integrated implementation
- a clear political commitment should be made to deliver the necessary new policies, and policy changes to existing arrangements, to ensure success at the implementation and operational stages.

The highlights are that integrating Global Navigation Satellite Systems and Satellite communication with Galileo in particular but also with GPS and GLONASS will deliver safety, efficiency and environmental benefits for all forms of transport. The benefits identified for the individual modes of transport are described in this report.

To achieve these benefits key policy issues have been identified and consideration of these have led to the formulation of Policy Requirements common to all modes. These Policy Requirements mainly concern:

- the creation of a European Satellite Information Service Authority with wide ranging powers over the satellite based infrastructure,
- the commitment to harmonise standards of all types,
- the commitment to achieve interoperability with existing systems,
- the commitment to maximise commercial exploitation.

Legal issues

The integration of the information, communication and navigation technologies in transport raises several legal questions. After having analysed several case studies, four aspects have been considered as being of high interest regarding the integration of the technologies mentioned above in transport: privacy, electronic payments, competition and liability.

In the field of privacy, the analysis of the European Directive on data protection has led to the identification of several legal questions mainly related to the personal data possibly collected in transport services and to the rights and obligations of the different parties (i.e. the data subject and the controller). A specific attention has been paid to the balance of interests that can exist between the public interests and the individual right to privacy.

[2] Galileo is the proposed European satellite system comparable to the American GPS and the Russian GLONASS systems but free of the restrictions imposed by these systems.

In the field of electronic payments, two particular instruments have been analysed: the credit cards and the reloadable payment instruments. Several questions are raised by the use of these instruments. In the case of the credit card, the legal questions are mostly related to the problem of giving the evidence when that instrument is used in distance contracts. There are also difficulties in the case of loss or theft of the instrument and the consequent liability of the parties. Concerning the reloadable instruments, the attention is more focused on the possible threats to privacy caused by the storage on the smart card of information of different natures (information related to payment, information related to the holder's identification). The access to this information must be granted only to the relevant persons.

Even if it has been contested in the past, the application of competition law to the transport sector is nowadays certain. This sector is characterised by a network architecture that consists of an infrastructure, most of the time non-duplicable, and several final services needing an access to the infrastructure to be provided. Nowadays, as a lot of infrastructures are privatised and the services are liberalised, one of the most challenging questions about the application of competition law to the transport sector consists in the guarantee of a fair access to the monopolised infrastructure for the service providers. To ensure this access, the essential facilities doctrine, based mainly on article 82 of the EC Treaty, has been developed. As this theory seems, most of the time, insufficient, the Council has adopted sector-specific regulations that impose obligations to the infrastructure operators. Although the integration of new technologies in transport does not raise very new questions in competition law, it could raise some new possibilities of anti-competitive conducts, which could justify some adaptations or, at least, new interpretations of the sector specific regulations.

The liability issue has been approached in the framework of the European contribution to GNSS-2 (GALILEO). The main legal questions raised in this domain are related to the lack of a liability framework in case of damages caused by errors in or failures of the basic signal and/or the value added services. Today there is neither an international Treaty nor a European Directive able to face the liability issue. An ideal solution would therefore be the adoption of a new Directive tackling this issue. This European action should be in conformity with article 5 (ex-article 3B) of the Treaty establishing the European community . The international applications of GALILEO and the existence of different points of view concerning the notion of fault in the Member States, seem to answer to the requirements of this article and allow a Community action.

For each of the four main domains presented above, the report describes a number of policy options to solve the legal questions raised.

Socio-economic issues

The effectiveness and efficiency of policy measures with respect to the integration of information, communication and navigation technologies in transport depend on the multiplied effect of two factors:

- the effectiveness and efficiency of these measures in promoting integration;
- the strength of the link between integration and socio-economic performance.

From this, two basic criteria for policy relevance and policy priorities can be derived. Policy makers should focus on those areas of integration where policy measures have a significant influence on the promotion of integration, and where the socio-economic impacts of integration are large.

The impact of the integration of information, communication and navigation technologies in transport on socio-economic conditions is a very complex process. A large number of causal relationships are involved, many of them indirect.

The socio-economic impacts of integration are seen to operate through two chains:

- through the transport sector;
- through the information, communication and navigation technologies sectors.

Furthermore, in each chain, there are socio-economic impacts caused in the sector itself (i.e. the transport and information, communication and navigation technologies sectors), as well as indirect impacts resulting from the impact of the sector on the rest of the economy. Both impact chains are described and analysed in the report.

Some estimates of the overall socio-economic significance of the most important impacts of the integration of information, communication and navigation technologies in transport show that the largest effects come from gains in efficiency and safety. They are also described in this report.

Compared to the impact through the transport sector, the impact through the information, communication and navigation technologies sectors is relatively small. Transport-related information, communication and navigation systems only represent a small percentage of the total expenditures on information systems and services. Its effect on employment and technology development in the information, communication and navigation technologies sector is therefore small.

The estimates mentioned above give a useful indication of the order of magnitude of the impacts, but must be interpreted with caution. As already said, the causal relations linking the integration of information, communication and navigation technologies in transport and socio-economic impacts are very complex. There are many uncertainties in the knowledge about these links, mainly related to the following factors:

- the network context of transport,
- the presence of feedback effects,
- insufficient validation of socio-economic costs and benefits,
- the available evidence is largely determined by experiences from road transport, where most pilot projects have taken place.

In order to effectively set policy priorities for the integration of information, communication and navigation technologies in transport, the gaps in the knowledge on the socio-economic impacts of integration must be addressed. The following actions are important in this respect:

- promote the development of strategic transport models and of transport/land use/economic interaction models. Such models are required to take system and feedback effects into account. Suitable models are in fact already available, but they need extensive data to produce useful results. Therefore, more effort must be devoted to assure the collection of the necessary transport and socio-economic data across the European Union to render these models truly operational and useful for policy assessment.

- promote the evaluation of socio-economic effects in the validation of pilot projects. In this way, reliable data is collected on the direct effects of the integration of information, communication and navigation technologies in transport, which can complement macro-economic and regional data to be used as an input in strategic assessment models. Guidelines for socio-economic assessment have already been developed, but they are not always implemented in the same degree.

However, even in the absence of more precise information on the impacts of integration, some conclusions can be drawn on policy orientation. One policy priority, meeting the two criteria of policy relevance mentioned above, is systems promoting safety. The benefits from the integration of information, communication and navigation technologies in transport in improving road safety account for a large fraction of total potential integration benefits. The areas where integration of information, communication and navigation technologies in transport has effects on safety therefore seem to be the areas where government intervention is necessary to remedy market failures, and where the socio-economic stakes are high.

Conclusions

The economic growth within the European Union and the future enlargement of the European Union will certainly lead to a huge increase of the transport demand. But more and more resistance is found in the Member States to a major expansion of the existing infrastructures because of its negative impact on the environment. In this context, it is crucial to achieve a better use and management of existing infrastructures and facilities in all transport modes while at the same time maintaining or even increasing the level of safety.

The integration of information, communication and navigation technologies in transport may contribute to a safer, more efficient and sustainable transport system, and may contribute to minimise the negative effects of transport growth. However, political support is needed to ensure the success of the integration. For this reason, TRANSINPOL has concentrated on providing policy makers with appropriate information to develop their policies in this field: a framework for policy assessment and a set of functional and operational policy requirements.

While the operational approach rather reflects the "traditional" way of formulating policy requirements (strongly focussed on the elimination of the barriers hindering the development and deployment of new systems and services), the functional approach concentrates on the final impacts of the integration, in terms of changes introduced in the transport sector.

In making the difference between functional and operational policy requirements, an attempt has been made to draw policy makers' attention to the opportunity they have to assure that the final impacts of the integration of information, communication and navigation technologies in transport do contribute to the objectives of the Common Transport Policy.

Partnership

Co-ordinator	France Développement Conseil (F)
Technical co-ordinator	Directoraat Generaal Rijkswaterstaat (NL)
Work package leaders	TNO-Inro (NL) PLS Consult (DK) Northern Lighthouse Board (UK) Facultés Universitaires Notre Dame de la Paix (B) Technum Flanders Engineering (B)
Other Contractors	Sema Group (E) Telematica (D) VBB (S) Fraunhofer-ISI (D)

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1. Objectives

To provide policy requirements…

TRANSINPOL is a strategic transport research project[3] which addresses the integration of information, communication and navigation technologies in transport[4].

Through the development and deployment of new systems and services, these technologies have the potential to support the objective of the Common Transport Policy (CTP) by contributing significantly to a safer, more efficient and sustainable transport system. However, in order to ensure maximum benefit from the integration of the above mentioned technologies, it is necessary to identify and to describe the most pressing issues that policy makers should address (requirements for policy intervention) as well as the possible options available to them.

The main objective of TRANSINPOL is to provide policy makers with this information in order to enable them to develop, within the framework of the CTP, a policy for the integration of information, communication and navigation technologies in the transport sector. During the research and in this report, the requirements for policy intervention and the associated options have been designated by the generic term **"policy requirements"**.

To achieve this objective, TRANSINPOL covers political, technological, organisational, institutional, legal, and socio-economic aspects, primarily at the European level, but also at the level of national and local authorities.

To provide a framework for policy assessment…

The relative poor perceptibility of the opportunities offered by technology integration, the rapid evolution of technology and the increasing dynamics of the transport market make it hard to formulate appropriate policy requirements. As the policy making process is a complex exercise by its very nature, an other objective of the project has been to describe in a clear and structured way:

- the elements likely to have an impact on the integration of new technologies in transport,
- the relations between these elements,
- the different steps leading to the formulation of policy requirements.

The description of the elements, relations and steps mentioned above has been designated by the generic term **"framework for policy assessment"**.

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[3] TRANSINPOL was launched by the European Commission Directorate General for Transport in January 1997, as part of the Transport Research Programme of the Fourth Framework Programme.

[4] In order to avoid repetition, the expression "**integration of information, communication and navigation technologies in transport**" is often replaced by the simple term "**integration**" in this report. When used alone, the term "integration" keeps the meaning of the complete expression.

The design and use of the framework for policy assessment serves several objectives. First of all, the framework for policy assessment is a description of concepts and relationships in several domains (transport, information, communication and navigation technologies, integration…) and includes the explanation for changes, i.e. the dynamics. Secondly the framework for policy assessment gives a scheme how to assess policy options. Since actual policy-making is not only a rational process, such a scheme intends to be a model to support the design of a policy action plan. Thirdly, the framework has been used as a backbone for carrying out the project and also helped to structure the reports. As such, the framework for policy assessment has really been a growing concept during our work.

To be a starting point to formulate transport policies…

The result of TRANSINPOL (and in particular the framework for policy assessment) is a high level overview of the major components of the integration. The advantage of such an approach is that it helps to see the relationships between the multiple projects, proposals and different viewpoints in the fragmented markets of the transport world and the many particles of the fast developing "information society". During the work, one of the exciting findings was the great similarity of key questions and possible solutions in situations where many of the involved actors do not even realise that this similarity exists. People often overestimate the uniqueness of their position and thus overlook opportunities that are already identified somewhere else in transport and might speed up the development enormously. This is especially relevant where specific supply chains or modes in Member States or regions are in a relative minor position in comparison to the overall development of the information society, which is more internationally and even globally oriented.

During the project and in addition to the policy requirements and the framework for policy assessment, a few "lines of thinking" have been identified:

- information, communication and navigation technologies must be put (high) on the agenda of transport policy makers and *vice versa* transport must be put on the agenda of developers and policy makers in the field of information, communication and navigation technologies.
- the holistic (integral) view, either illustrating common goals within separate parts of the market or the public sector, helps to find solutions to similar problems in other cases and circumstances.
- understanding trends in the concerned domains (transport world, society, technology…), understanding the interdependencies between them and considering these elements according to various perspectives (market perspective, user perspective, socio-economic perspective…) enable to better understand the scope of the possible policy actions as well as their expected impacts.
- using an approach based on the transport function that the technology can fulfil (notion of "generic service") rather than on the technology itself facilitates considerably the formulation of policy requirements.

- having a list of issues indicating where to start the formulation of policy requirements facilitates the task of policy makers. The project provides not only a list of policy requirements but also, for each step of the process leading to policy requirements, a list of issues to be considered (types of markets, types of actors, list of generic services, list of barriers, list of policy issues, list of areas for policy attention,…).

Although we realise there is a long way to go from the generic lines above to actual policy making in specific situations, it has been the intention to come to elements that are applicable in the formulation of transport policy. In this context, TRANSINPOL is a starting point, as a first "cookery book", where we hope that at least the lines of thinking may influence policy making.

2. Approach

2.1 General approach

As indicated in chapter 1, the integration of information, communication and navigation technologies in transport provides numerous opportunities to contribute to the achievement of the CTP objectives. In some cases, taking advantage of these opportunities may require to identify appropriate **policy requirements** or in other words, requirements for policy intervention. In addition to the information related to the need for policy intervention, the policy requirements also provide information about the options that policy makers have, in terms of possible policy actions, and about the conditions that can be put on these policy actions to guarantee their success.

During the project, two different approaches have been followed for the formulation of policy requirements: a functional approach and an operational approach. These approaches have naturally led to the formulation of two different kinds of policy requirements.

Functional approach

The integration of information, communication and navigation technologies in transport leads to new systems and services which may change transport, or the transport system, in various ways. In particular, the integration is expected to have positive impacts on the transport demand, on the supply of infrastructure services and on transport operations.

From a policy perspective, integration has a real policy function and can be seen like an instrument that policy makers can use to achieve the objectives of the Common Transport Policy. Finally, the research carried out during the project has led to the identification of six main policy functions and to the formulation of the associated needs for policy intervention, or **functional policy requirements**.

Operational approach

Identifying functional policy requirements is a crucial and necessary step but it does not totally guarantee that at the end, the expected impacts of the integration become a reality.

Once the integration process has started, many kinds of barriers can hinder it and affect the desired impacts of the integration in an unacceptable way. In a first step, the research carried out during the project has enabled to identify the domains in which barriers can be found (technology, legislation,…) and then the main barriers encountered in each domain (insufficient infrastructure, absence of commercial interest,…). This has finally resulted into a selection of the most frequently encountered barriers and into the formulation of the associated needs for policy intervention, or ***operational policy requirements***.

As expected, it appeared that the process leading to the formulation of policy requirements was very complex due to the number and diversity of aspects to be taken into account. Early in the project, the need for a more global and structured approach became rapidly evident. This has led to the elaboration of a **framework for policy assessment**, or in other words of a "tool" enabling to facilitate the policy makers' task.

The framework for policy assessment in itself has its own limitations as it illustrates in a fixed and logical way a process which is in practice dynamic and sometimes not completely rational. However, these apparent drawbacks also constitute the advantages of the framework for policy assessment. Indeed, this framework enables firstly to incorporate in an accessible way the numerous aspects to be considered, secondly to structure and exploit in a clear way available information and thirdly to identify and structure in a systematic way the major steps leading to the formulation of policy requirements.

2.2 Work phases

Basically, the research performed during the project has been divided into three main phases.

The first phase has been dedicated to the definition a common assessment framework, established by all the partners of the project and used all along the project (this framework mainly consisted in a set of definitions, methodologies to be used, etc.).

The second phase, which really constituted the main part of the project, has been dedicated to the formulation of policy requirements in the various domains covered by the project and to the elaboration of the framework for policy assessment. This major phase has been divided into four steps:

- "State of the art", based on case descriptions as well as on a general review of literature and running projects.
- "Needs and opportunities", dedicated to the identification of needs for integration and opportunities offered by integration.
- "Policy issues", dedicated to the identification of barriers and policy issues related to the integration
- "Policy requirements", dedicated to the identification and formulation of the major policy requirements

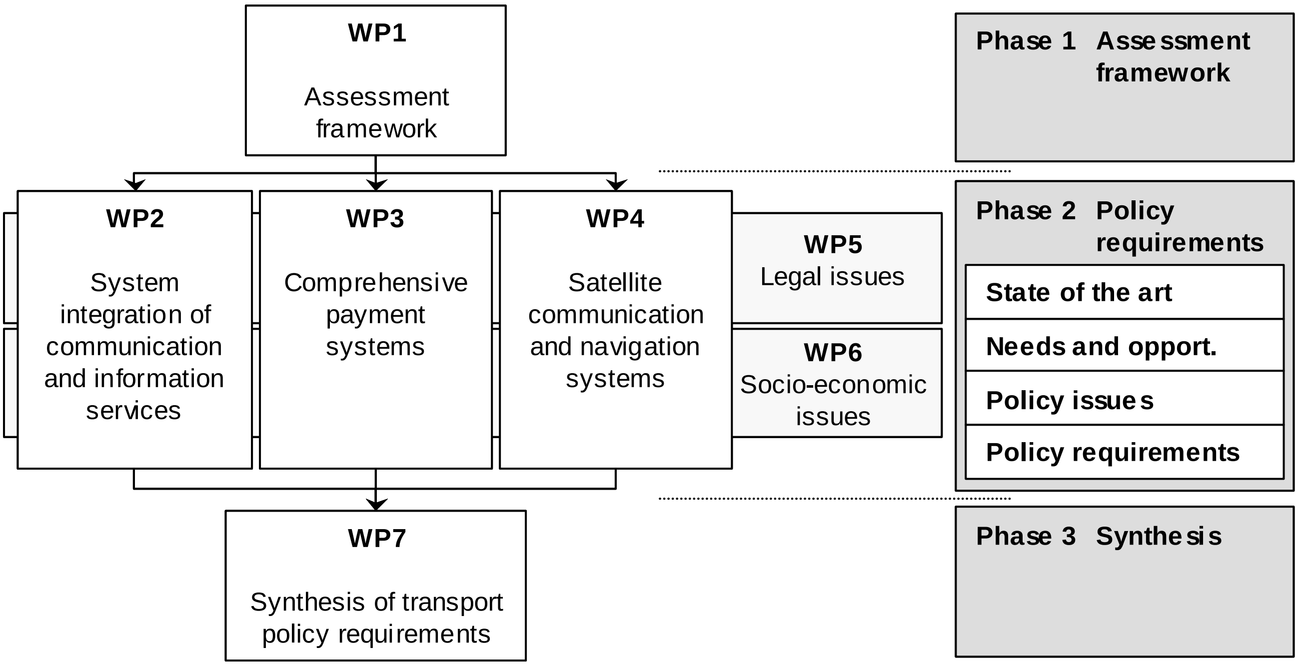
The third and last phase aimed at providing a synthesis of the policy requirements produced during the project and at refining the framework for policy assessment.

Specifically at the beginning and the end of these phases, the work performed by the partners of the project was combined and integrated. The research basis and confirmation of TRANSINPOL, apart from the scope and experience of all the partners, has been based on literature review, interviews, case-studies, a number of workshops and a European wide survey in the summer 1999 where 132 respondents filled in a detailed questionnaire. A major source of information were the many technology-related and transport-related projects in the Third and Fourth Framework Programmes for R&D and also the exchange of information co-ordinated by ITS and ERTICO on similar developments in the US and Japan.

2.3 Work breakdown

In practical terms, the work performed during the project has been split into several work packages. The following figure illustrates the work package breakdown as well as the relationship between the work packages and the work phases mentioned above.

Figure 1: Work breakdown



2.4 Project deliverables

Work packages 2 through 6 have resulted into five main reports identifying the policy requirements, addressing the legal and socio-economic aspects and providing building blocks for the design of the framework for policy assessment. Work package 7 has resulted into a report presenting a consolidated framework for policy assessment and a synthesis of the policy requirements formulated within the other work packages. The details about the reports are available in the annex.

2.5 Structure of the report

As indicated previously, the project has resulted into a set of policy requirements covering the various domains addressed in the project and into a framework for policy assessment. The present report is structured as described hereafter.

Chapter 3 presents the two types (functional and operational) of policy requirements, describes the framework for policy assessment and provides a synthesis of the policy requirements obtained throughout the research (source: work package 7).

Chapter 4 presents the policy requirements related to the integration of information and communication services in transport (source: work package 2).

Chapter 5 presents the policy requirements related to the integration of Comprehensive payment systems in transport (source: work package 3).

Chapter 6 presents the policy requirements related to the integration of satellite communication and navigation systems in transport (source: work package 4).

Chapter 7 presents the legal impacts of the integration of information, communication and navigation technologies in transport and identifies the associated policy requirements (source: work package 5).

Chapter 8 presents the socio-economic impacts of the integration of information, communication and navigation technologies in transport and identifies the associated policy requirements (source: work package 6).

3. Synthesis of policy requirements

The present chapter describes the two types of policy requirements identified during the project (section 3.1), presents the framework for policy assessment (sections 3.2 and 3.3) and provides a synthesis of the policy requirements obtained throughout the various work packages (sections 3.4 and 3.5).

3.1 Types of policy requirements

The integration of information, communication and navigation technologies in transport introduces changes in the transport sector and in the society in general (see chapters 2 and 4 of deliverable D6). It is therefore tremendously important to ensure that the impacts of the integration do contribute to the achievement of the CTP objectives, and more generally, of the policy objectives of the European Union. Ensuring this contribution may require policy intervention. It is therefore necessary to identify what are the needs for policy intervention, i.e. what are the policy requirements.

In the absence of policy intervention, integration is driven by market forces only: some integrations take place because the private sector has an interest in the expected changes and stimulates the integration process, while other integrations do not take place because of market failures[5] (e.g. the benefits are not attractive for the private sector).

Integrations driven by the private sector are generally in line with the CTP objectives (e.g. when integration leads to a better efficiency). However, in some cases, the introduced changes can be conflicting with the CTP objectives (e.g. when integration leads to a better efficiency but decreases the level of safety) and policy intervention becomes necessary either to prevent the integration (through legislation for instance) or to limit its negative effects (by imposing minimum levels of safety for instance).

Among the integrations which do not take place due to market failures, some integrations may however have a strong potential to contribute to the CTP objectives (e.g. integrations increasing the level of safety). In this case, policy intervention is required to ensure that integration takes place and that the desired changes will occur. It appears that integration can be a powerful "instrument" that policy makers have at their disposal to achieve their objectives.

In the two cases identified above where policy intervention is necessary (market-driven integrations with negative effects towards the CTP objectives and integrations having the potential to contribute to the CTP objectives but not supported by the market), the need for policy intervention is directly related to the role or function that the integration can have in the achievement of the CTP objectives. For this reason, this type of need for policy intervention is called functional policy requirements.

> ***Functional policy requirements*** *are needs for policy intervention to ensure that the impacts of the integration contribute to the achievement of the CTP objectives.*

[5] The different types of market failure are identified in deliverable D6, chapter 3.

However, identifying and formulating functional policy requirements is necessary but not always sufficient to ensure that, at the end, the expected changes will really occur.

Once the integration process has started, many kinds of barriers can hinder the integration process (e.g. differences in national legislations, lack of standards…) and affect the desired impacts of the integration in an unacceptable way.

Therefore, it is important not only to ensure that the expected impacts of the integration are in line with the CTP objectives (role of the functional policy requirements), but also to ensure that integration takes place in time, and to minimise possible deviations from the expected impacts. When the solutions to overcome the barriers do not come from the private sector, policy intervention is needed. This type of need for policy intervention is called operational policy requirements.

> ***Operational policy requirements*** *are needs for policy intervention directly related to the necessity to overcome the barriers that may hinder the integration process.*

The elements, relations and steps to be taken into account when formulating functional and operational policy requirements are described in the two following sections.

3.2 Policy assessment elements and relations

In the field of integration of information, communication and navigation technologies in transport, policy makers have to consider five main elements for the assessment of policy requirements. These elements are:

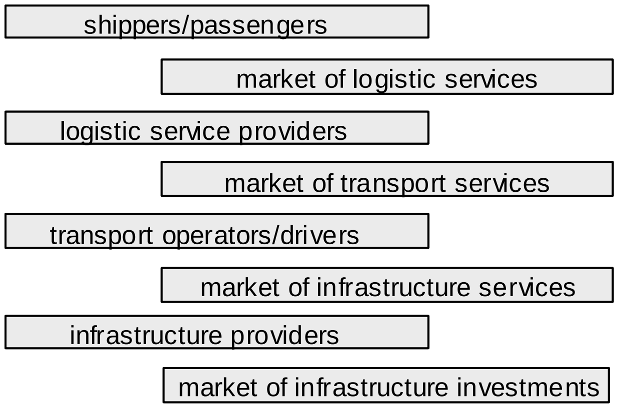
1. the **transport** sector
2. information, communication and navigation **technologies**
3. **generic transport telematic (TT) services**
4. the **Common Transport Policy**
5. the **integration** process

The **transport** sector is characterised by a wide variety of actors and markets[6]. These actors and markets can be grouped each into four categories (see *Figure 2*). Each category of actors has typical needs for integration of information, communication and navigation technologies. These needs result from the objectives of the actors and the dynamics of the markets in which the actors are operating. For the assessment of policy requirements it is important to identify these typical needs and to analyse the drivers for the integration of the technology.

[6] Actors and markets are described more in detail in Deliverable D2, chapter 3.2

Example: *transport operators offer transport capacity and perform the transport of goods and passengers. Their main objective is to maximise the efficiency by grouping the transport demand. Infrastructure providers provide transport operators with access to the infrastructure. Their main objective is to optimise the allocation of the existing infrastructure capacity. In some cases, transport operators' needs and infrastructure providers' needs may be contradictory.*

Figure 2: Transport actors and markets



The second element concerns the information, communication and navigation **technologies**. The development of these technologies is generally driven by non transport markets, resulting in new generic products in terms of systems or services which can be used directly or indirectly for transport purposes. Trends in availability, performance, reliability, costs, sustainability and basic functionality of these technologies are of particular importance for the assessment of policy requirements.

Example: *trends in the communication field show that liberalisation and privatisation have led to a high degree of competition. In the GSM case for instance, services are offered very cheaply in order to obtain market shares before the market stabilises.*

The **generic transport telematic (TT) services**[7] group together telematics systems and services which have the same transport functionality. Eight different categories of generic TT services have been identified. The use of these generic TT services facilitates the analysis of the policy importance of potential integrations and the formulation of policy requirements.

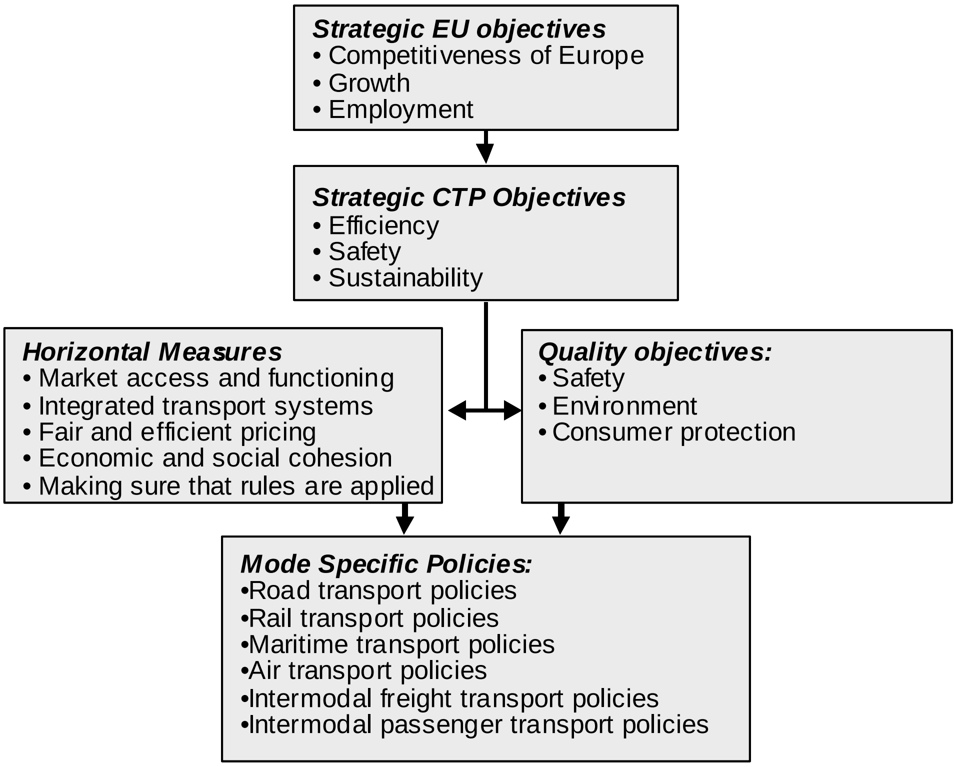
[7] Generic Transport Telematic Services are described in Deliverable D2, chapter 3.4

Table 1: Generic TT services

Service	Functionality
Market information	To provide user information about existing transport-specific services present in the market (logistic, transport or infrastructure services)
Transactions	To enable transport operators and users to perform the actions required (in terms of payment, ordering, invoicing…) for the use of the services
Transport operation management	To provide transport operators with tools facilitating the planning and execution of transport operations
Navigation	To guide users of transport or information services in a safe and efficient way to their destination
Traffic & travel information	To inform users or potential users about the traffic or travel conditions
Traffic management	To provide traffic operators the information required for a safe and efficient traffic management
Communication	To enable users or operators of transport-specific services to communicate (emergency services, data exchange…)
Others	To provide services generally not specific to transport (statistic, insurance…)

The fourth element concerns the **Common Transport Policy**. The policy importance of the integration of a technology is determined by its potential contribution to the strategic objectives of the CTP (efficiency, safety, sustainability) and to the general strategic objectives of the European Union (competitiveness, growth, employment). The current translation of the strategic objectives of the CTP in terms of horizontal measures, quality objectives and operational policy plans (see *Figure 3*) offers a practical scope to position the integration of information, communication and navigation technology within the CTP.

Figure 3: Translation of strategic policy objectives into specific policies



The **integration** process can be defined as the development and deployment of new or improved systems and services.

> *Example:* *new or improved systems and services are for instance, air traffic management systems based on GNSS, internet-based personal multi-modal travel information services, electronic ticketing systems for collective transport, car navigation systems based on global positioning services,…*

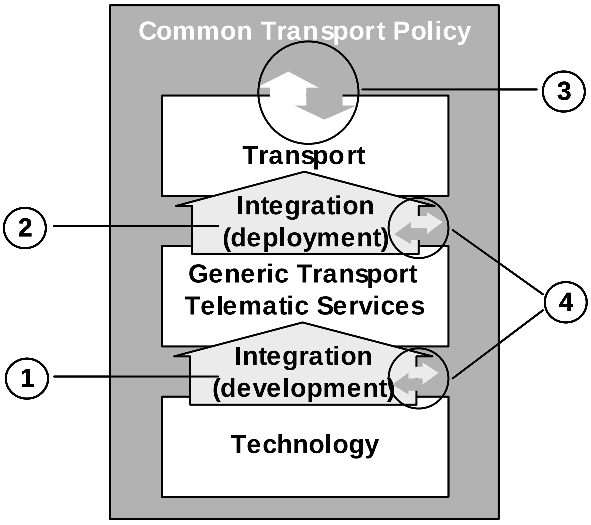
In the development phase, technology is integrated into a transport specific system or service. These new systems and services are then deployed into the transport sector. Policy requirements can be formulated for both the development phase and the deployment phase.

The five elements previously described are correlated together and changes or developments occurring in one element will generally impact the other elements. It is therefore essential for the assessment of policy requirements to be aware of what is going on in these elements, to capture signals indicating changes and to consider the relations between these elements.

Because they represent a major field of assessment, the **relations** between the elements mentioned above are of particular importance for the formulation of policy requirements. These relations[8] mainly concern the relationship between:

1. technology and Generic Transport Telematic Services (development phase of the integration process)
2. Generic Transport Telematic Services and the transport sector (deployment phase of the integration process)
3. the Common Transport Policy and the transport sector
4. the Common Transport Policy and the integration process

Figure 4: Relations between the elements of the Framework for policy assessment



Relation between technology and generic transport telematic services (1).

The development of new information, communication and navigation technologies enables the development of new transport-specific systems and services. Some of these technologies may even be essential for the development of these systems and service.

> *Example: the existence of satellite positioning technology enables to develop localisation or navigation services operating with a European coverage.*

For the formulation of policy requirements, it is important to know the opportunities offered by the technology in terms of potential integrations and also to know the level of sustainability of these technologies.

[8] The descriptions provided in this report are a summary of the existing relations. More detailed descriptions of these relations are given in Deliverable D2, chapter 2.2

Relation between generic transport telematic services and transport (2).

The generic TT services are associated with typical transport (system) activities. The desired changes of these activities (e.g. better performance) generate needs for new (or at least improved) functionalities. These needs are closely related to the current status of these functionalities and expected short term changes. In turn, these needs for new or improved functionalities result into needs for the integration of new telematic systems and services in transport. In the policy making process, the use of generic services facilitates the translation from required transport (system) changes into needs for integration.

The integration of new systems and services in transport may be slowed down or even blocked by various barriers (e.g. lack of co-ordination). Indications about the presence of these barriers and the potential impact on the deployment are essential for the formulation of policy requirements.

Moreover, the integration of new telematic systems and services in transport, which is generally driven by the interest of one or several actors of the domain, may represent opportunities to change the transport system into the directions defined in the CTP. The expected result of the integration in terms of impact on the transport system contributes to the assessment of the policy importance of the integration. This is also essential for the formulation of policy requirements.

> *Example:* *the existence of European wide communication and localisation systems and services would enable for instance to deploy more efficient fleet management systems (thus improving, at a more general level, the global efficiency of the transport system, which is in line with the CTP objectives).*

Relation between the CTP and transport.

The CTP is directed towards improvements of the transport system (in terms of efficiency and safety) and changes in the use of the transport system (in terms of sustainable mobility). The CTP is therefore at the origin of many of the "desired changes" of transport activities mentioned above.

In order to reach these strategic objectives, the CTP has specified in different documents how these strategic objectives might be achieved in the future. It is important to realise that even if the current transport problems which constitute the drivers behind these specifications may change in the far future, the strategic objectives however will not change. Consequently the strategic objectives are of high interest because they constitute a stable basis for the formulation of policy requirements.

Relation between the CTP and integration

As indicated previously, integration may offer opportunities to change the transport system into the directions defined in the CTP. Within the context of the CTP, the importance of a given integration depends on its potential to contribute to the objectives of the CTP. For the formulation of policy requirements, it is therefore essential to determine how to ensure a real contribution of the integration to the CTP (functional policy requirements) and to create favourable conditions for the integration (operational policy requirements). This mainly concerns the deployment phase of the integration.

Nota Bene: the CTP contains action plans for the integration of particular technologies (e.g. the GNSS action plan) which may already contain policy requirements directly related to information, communication and navigation technology.

As far as the development phase of the integration is concerned, the evolution of information, communication and navigation technologies is not influenced by the CTP. However, through the need for new transport specific systems or services, the CTP may indirectly stimulate the need for new technologies. In the same way, technology developments may impact the need for new systems and services in transport, thus forcing the CTP to review the plans for the integration.

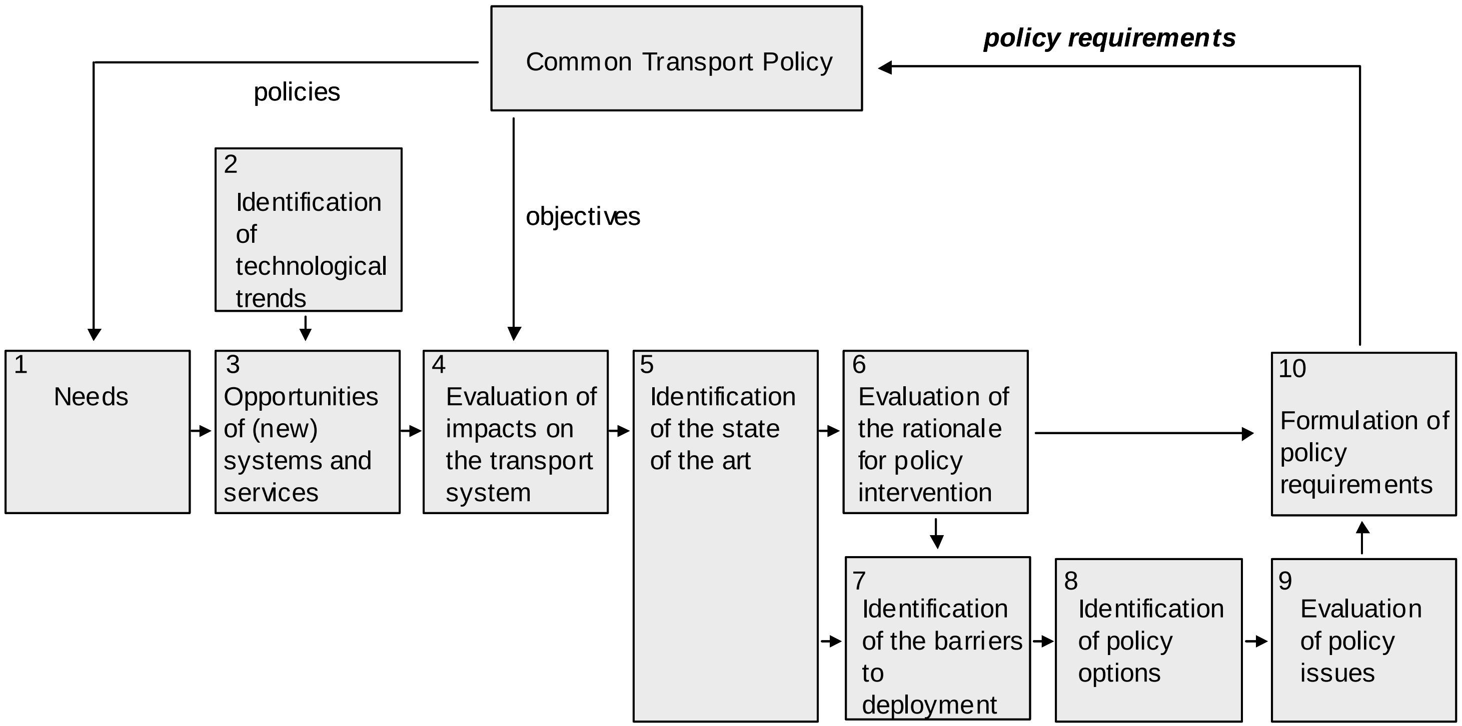
3.3 Policy assessment steps

The policy assessment process leading to the identification and formulation of policy requirements for the integration of information, communication and navigation technologies incorporates in a logical way the various elements and relations described in the previous section. This process can be split into a number of assessment steps. These steps are identified and described hereafter.

> *Remark:* *for each step of the policy assessment process, an example is given in order to illustrate how the step works (on no account the purpose of the chosen examples is to be exhaustive). All the examples are related to the same subject: what has to be done at a policy level to ensure that integration of information, communication and navigation technologies in road transport contributes to more safety? Keeping the same subject through all the examples enables to better illustrate how the framework for policy assessment can help to formulate policy requirements.*

Of course, due to the dynamics of the policy making process, each situation may be different: some steps may be performed in a different order, some steps may be carried out simultaneously, some steps may be skipped or to the contrary performed several times (iterative process). The description given hereafter however enables a systematic identification and structuring of the various steps.

Figure 5: Policy assessment steps



Step 1 "Needs" has the objective to identify the long term needs of the transport system. These needs may result either from the market or from the CTP (e.g. need for more safety).

Concerning needs arising from the market, they are related to the required future performance of the transport system and to the required changes in the use of the system. These needs originate usually from observed bottlenecks in the functioning of the system like congestion, absence of market transparency in demand and supply of transport services, lack of competition between operators or the absence of particular services. They are formulated by the various actors in the transport markets (these actors and the four transport markets are illustrated by *Figure 2*). Each market can be divided into sub-markets which have their own dynamics, characteristics and organisational/institutional environment. Some of these sub-markets are global, others are European ones or even have a local nature. Each sub-markets has different types of actors, with their own objectives and perceptions about the market.

Example: *(needs) one of the needs of transport is to improve safety, particularly in the field of road transport (in the European Union, about 45 000 persons are killed in transport each year, almost exclusively in road transport). This needs does not raise from the market but from the objectives of the CTP.*

Step 2 "Identification of technological trends" consists in identifying the trends in technology from a market perspective. The trends are found within the market for generic information, communication and navigation technologies. Similar to the transport market division, the market for this category of technologies may be divided into sub-markets, as illustrated by the following table.

Table 2: Information, communication and navigation technologies sub-markets

Sub-markets	Major trends
User products	Information: development of new services for the management and linking of database information. Shift from the use of information systems towards the use of services, despite an increase of the cost of these services. Improved products for search and selection of information are emerging. Communication: impact of the liberalisation and privatisation becomes clearly visible in terms of decrease of prices due to the presence of more competition. The GSM developments show a trend towards more functionalities and smaller user equipment. The possibilities to forward information using radio based communication services are rapidly increasing due to the integration of new transmission technology. Navigation: positioning and navigation products are more and more miniaturised and integrated in other user devices like cellular phone, watches, etc. Their cost continues to decrease.
Network products	Increasing number of terrestrial and satellite based networks for communication, (already 6 networks for mobile satellite communication). Integration of satellite positioning network services in mobile telecom networks for network synchronisation.
Infrastructure investments	Investments in satellite networks for mobile personal communication may slow down due to the growing uncertainty about the future number of users of this type of infrastructure, consequence of the developments of terrestrial networks. Investments in satellite positioning network should increase due to the strategic decision of Europe to obtain a more important position on the satellite positioning market.

The impact that trends of the information, communication and navigation technology market may have on the integration of the technology in transport requires to be assessed. This assessment has to focus on the technologies which have a real interest for the development (or the improvement) of transport-specific systems and services, like for instance:

- collection and storage of information
- transmission of information
- information processing
- user interfaces for mobile use
- mobile data communication networks
- satellite positioning systems

Example: *(technological trends) information, communication and navigation technologies are likely to be used for safety purpose. In the case of communication technology for instance, the fact that more and more communication networks exist (based on a same technology-GSM), with a wide coverage and offering an increasing number of function can stimulate their use in road transport. Moreover, the fact that equipments are more and more* *miniaturised and cheaper contribute to facilitate their integration in vehicles.*

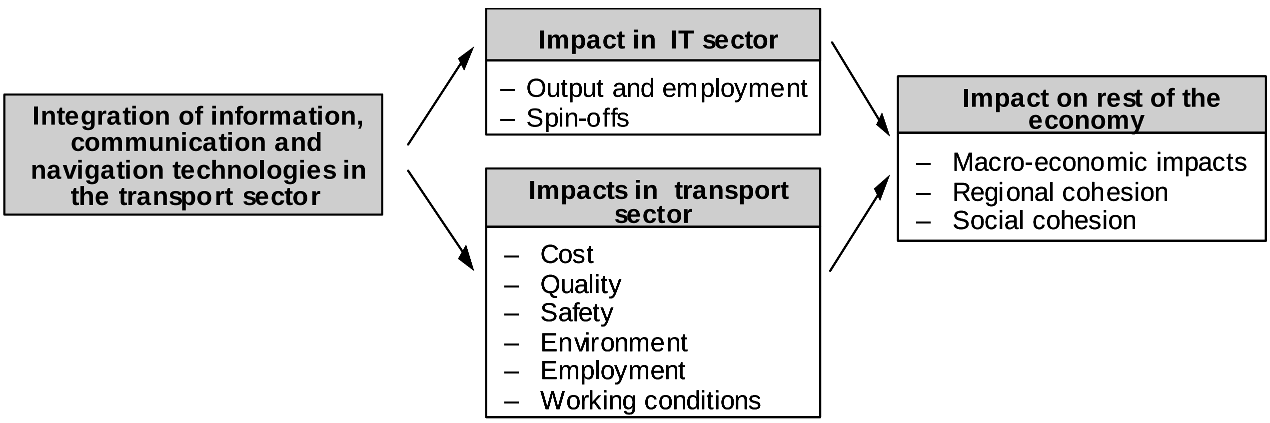
Step 3 "Opportunities of (new) systems and services" consists in identifying the opportunities for the development of new systems and services or the improvement of existing ones. Based on the long term transport needs identified in step 1 (coming from either market needs or political will) in terms of required changes, the need for enhancement of generic services is determined. Given the trends identified in step 2, this need is translated into opportunities for the integration of new systems and services and for the improvement of existing systems and services.

Example: *(opportunities) the current trends in the development of information, communication and navigation technologies are favourable to the development of transport-specific services which can directly contribute to the improvement of safety in road transport. Among these services one can quote: emergency and distress systems, incident management systems, navigation systems (based on global positioning and digital mapping), collision avoidance systems, etc.*

Step 4 "Evaluation of impacts on the transport system" has for objective to assess the impacts[9] that the translation of opportunities into reality would have on the transport sector and to assess whether these impacts are consistent with the CTP objectives.

The direct impacts on the transport sector can be divided into impacts on cost drivers (e.g. savings in transaction cost, improvement of efficiency…) and impacts on market functioning (e.g. market transparency, pricing practices…). In the process leading to the formulation of policy requirements, the direct impacts on the transport market are of high interest, not only because they result into major changes in the transport sector but also because they may result into significant changes in the rest of the economy and the society (see *Figure 6*).

Figure 6: Impacts channel



[9] impacts are addressed in deliverable D6, in a general way but also more specifically for each generic transport telematic service with both qualitative and quantitative elements.

Example: *(impacts) traffic monitoring and management systems have a direct positive impact on safety by informing drivers about hazardous traffic conditions (accidents, fog…). In pilot projects, such systems have led to a significant reduction of the number of accidents (15-20%). Emergency call systems have led to a reduction of the response time of approximately 40% (which has led to a reduction of approximately 10% of the number of killed persons). Information services have not necessarily a direct impact on safety. However, by inciting people to choose any other transport mode than road (which is the most dangerous one), they can indirectly contribute to reduce the number of accidents. Moreover, reducing the number of accident has not only an impact on the number of killed or injured persons but also on the cost of transport accidents (medical cost, material damage,…).*

Step 5 "Identification of the state of the art" aims at assessing the progress made in the development and deployment of the systems and services identified in step 3. At this stage, it is also important to identify if policy requirements have already been formulated in the domain, and in the affirmative, to identify the reasons behind these requirements and the effectiveness of policy actions.

The state of the art serves as a basis for both step 6 and step 7.

Example: *(state of the art) in terms of development, the technologies which are likely to be used for improving safety are available and sufficiently mature (e.g. localisation systems, digital radio communication, variable message signs…). However in term of deployment the telematic services which could directly contribute to more safety are on a highly fragmented market. A European dimension is still lacking in the use of these systems.*
(Remark: a complete state of the art should cover several other aspects like the organisational and institutional environment, user needs and requirements, etc.)

Step 6 "Evaluation of the rationale for policy intervention" aims at determining if a European political involvement is needed in the integration process.

In some cases, integration requires, by nature, a political involvement at the European level (for instance when the integration is strongly needed but cannot be achieved without funding from the European Union). In other cases, it is necessary to evaluate if yes or no a political involvement is needed at the European level.

In this case, the three following elements[10] have to be considered:

- contribution to the objectives of the CTP and to the strategic objectives of the European Union. The contributions to the objectives of the CTP vary in magnitude and importance. The strategic value of an integration in terms of political functionality may constitute an important factor in the evaluation of the need for policy intervention.
- status of policy action plans
- expected effectiveness of policy actions at the European level (including sustainability of the impacts of the integration)

In general, there are several reasons for policy intervention within the scope of the CTP:

- the contribution to the objectives of the CTP are difficult to realise without policy intervention at the European level
- without policy intervention at the European level, the integration may have undesirable negative effects on the transport market

This step results into the identification of candidate integrations for policy intervention at the European level. These candidate integrations are further assessed to formulate either functional policy requirements (step 10) or operational policy requirements (steps 7, 8, 9 and 10).

Example: *(rationale for policy intervention) As indicated in the example given in step 3, the integration of information, communication and navigation technologies in road transport may contribute significantly to improve safety, thus contributing directly to one of the major objectives of the CTP. However, development and deployment of dangerous goods monitoring systems, emergency call systems etc mainly serve the public sector. The implementation of these systems will not be spontaneously supported by market needs. There is a need for policy intervention in order to stimulate the integration of these types of systems.*

At this level, that is to say after having completed steps 1 through 6, all the information required to formulate a functional policy requirement is available (see for instance the functional policy requirement related to transport safety given in chapter 3.4). The other steps will lead to the formulation of operational policy requirements.

[10] These elements are described in deliverable D2 (chapter 3.7)

Step 7 "Identification of the barriers to deployment" aims at identifying the barriers which risk to affect the success of strategic integrations. Among the wide variety of barriers, some ones are general in nature whereas others are related to a specific integration. Important general barriers within the European Union are for instance: the lack of information, non conformity of information definitions, privacy and confidentiality, lack of guarantees in the provision of generic technology, lack of powerful actor(s) to initiate developments, proliferation of stand-alone solutions and the persistence of existing procedures, and differences in national regulations.

Example: *(barriers) as indicated in the example given in step 3, several systems based on global positioning can contribute to a better safety of transport. One of the barriers to the integration of systems based on satellite positioning is for instance the uncertainty about the future cost of the basic service (will it be free as GPS is today?) and of the value-added services (what will the cost be for the final user?).*

Step 8 "Identification of policy options" aims at identifying the policy options likely to minimise the barriers identified in step 7, taking into account the available policy instruments

Table 3: Community instruments

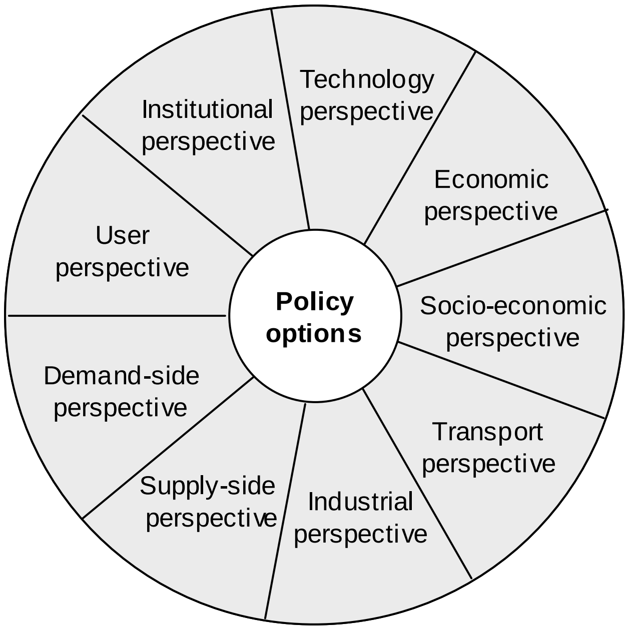
Research and development	Support research and development and demonstration activities…
Technical harmonisation	Implement measures to ensure the interoperability across national frontiers…
Co-ordination	Concert and co-ordinate national policies. Co-operation with third countries…
Financial support	Support project of common interest…
Legislation	Augment existing legislation, adopt new legislation, implement harmonisation measures…

Policy options correspond to alternatives and combinations in the selection of the community instruments or to alternatives in the use of these instruments. Policy options can be evaluated from different perspectives, however in this step only the effectiveness of the policy options for minimising or removing the barriers has to be taken into account.

Example: *(policy options) several options can be envisaged to overcome the barriers identified in the above example. For instance, more research could be envisaged in order to clarify the cost of the service for the final user (e.g. car drivers). This could take the form of thorough cost benefit analysis in the road transport sector. This however requires to have a good visibility on the envisaged applications, which is not necessarily the case today. In this context, a complementary option could be to stimulate the definition of a European strategy for the development of the user segment.*

Step 9 "Evaluation of policy issues" corresponds to the identification and evaluation of the various aspects associated to the policy options selected in step 8. These aspects, also designated by the term policy issues, mainly concern the impacts, advantages, drawbacks, and limitations of each policy option. The expected impacts of the policy options require a particular attention and need to be addressed from various perspectives. Nine different classes of perspectives have been identified, as illustrated on the following figure.

Figure 7: Policy options and perspectives



Important policy issues are listed hereafter for each perspective:

- transport perspective: balance between competition and co-operation in the market, consolidation of transport flows and balance between regulation and deregulation.
- industrial perspective: costs of new transport specific systems and services, availability of know-how within the European Union, global competition position of this industry, balance between competition and pre-standardisation, strategic importance of particular industries and need for industrial standards.
- socio-economic perspective: impact on elderly and disabled people, accessibility of new services, minimum required levels of provision at acceptable costs, and geographical availability of new services.
- demand-side and supply-side perspective: demand stimulation by legislation, incentives for transport actors to integrate future systems and services, availability of funds for integration of technology, organisation level of the actors, open/versus closed systems, incentives to the private sector, minimum required market size, role of public sector in the provision of systems and services, multiple service versus monopolies and diversity versus uniformity.
- economic perspective: acceptable differences in cost benefit ratio between the different actors in the integration, application of the user pay principle, acceptable

risk levels and possibilities to obtain special rates for particular transport categories.

- technology perspective: overall R&D policy, balance between integrated solutions and individual systems or services, post or pre-standardisation and up/down-gradability of systems.
- institutional perspective: reach of international legislation, effectiveness of European legislation within global markets, institutional requirements for public private partnerships and required level of legal protection.
- user perspective: required level of standardisation within the European Union, level of privacy protection, human machine interface and safe use of information, communication and navigation services in transport.

Example: *(policy issues) for the policy option consisting in defining a strategy for the user segment (see previous example), the various perspectives mentioned above must be considered. For the institutional perspective for instance, it appears that the existing legal framework is not adapted to the determination of liability in case of damage caused by accidents resulting from erroneous data provided by value added services (remark: this may lead to the formulation of other policy requirements not directly related to safety but to liability aspects).*

Step 10 "Formulation of policy requirements" corresponds to the final step of the policy assessment process. It leads to the formulation of functional and operational policy requirements, as indicated in section 3.1. Both types of policy requirements contain a number of "conditions" which must be fulfilled and a number of "political actions" which must be undertaken to guarantee a successful integration.

The functional and operational policy requirements which have been identified within TRANSINPOL are presented in the next chapter.

3.4 Functional policy requirements

Functional policy requirements are related to the policy function or role that the integration of information, communication and navigation technologies can play in the achievement of the objectives of the CTP (these objectives are presented by *Figure 3*).

This implicates that the policy role or function that new systems and services can have must be clarified. This constitutes a necessary basis to perform step 6 of the framework for policy assessment ("Evaluation of the rationale for policy intervention"). During the synthesis, four main policy functions related to the strategic CTP objectives have been identified:

- to improve the sustainability of the TENs through changes introduced in the transport demand,
- to improve transport efficiency through changes introduced in the management of the TENs,

- to improve transport efficiency through improved operational and logistic management,
- to improve transport safety through improved information and navigation services.

In addition to the main policy functions identified above, the integration may also have more specific policy functions, directly related to the horizontal measures and quality objectives of the CTP:

- to facilitate the future integration of transport systems through new common systems and services,
- to enable/facilitate the application of fair and efficient pricing through the introduction of European-wide electronic payment systems and services,
- to reduce the negative impact of traffic on the environment (reduction of travelled distances, shifts towards more environmental-friendly transport modes…).

Two other specific policy functions related to the horizontal measures might be relevant but have not led to the formulation of policy requirements:

- to increase the economic and social cohesion through the availability of new systems and services in all the European Union,
- to increase the possibilities to control the application of agreed rules.

On the basis of the policy functions listed hereabove, the synthesis of the information provided in deliverables D2 through D6 has resulted into a more detailed list of the potential major policy functions that the integration of information, communication and navigation technologies in transport can fulfil. These policy functions as well as the associated policy requirements are described in the following paragraphs.

Policy function: to change the transport demand

The integration of information, communication and navigation technologies in the society is expected to influence the transport needs due to the offered possibilities to organise work and production practices differently. Consequently, the real policy role that the integration of these technologies in transport can play depends also on the positive or negative impacts that the integration of these technologies in the society may have on transport. For the time being, it is therefore necessary to obtain more information about these impacts.

> *Policy actions could be initiated to improve the knowledge about the expected future impacts that the integration of information, communication and navigation technologies in the society may have on the transport demand.*

Remark: in this very case, the use of the integration as a policy instrument goes probably beyond the current boundaries of the CTP. However, this instrument offers an important possibility to influence more actively the transport demand and therefore is worth to consider.

Some of the future systems and services resulting from the integration of information, communication and navigation technologies in transport have the potential to influence the transport system demand in terms of choice of the transport mode or of choice of the time period. This may be in particular valid for information systems aiming at providing user-oriented and customised information about infrastructure and transport services. The project deliverables underline the lack of knowledge about the decisive factors which influence users' decisions and about the magnitude and sustainability of the resulting impacts.

> *Policy actions could be initiated to perform more research about the factors which influence users' choices. Moreover, given the poor existing knowledge about the real impacts of the integration when it is used to change the transport demand, future policy intervention in the domain should be conditioned by the availability of means enabling to monitor these impacts.*

In the specific domain of public transport, the introduction of comprehensive payment systems could lead to an increase of the number of users (due to the availability of an easy to use and uniform payment facility). In this case, the real impacts of the integration on transport demand strongly depends on the presence of other policies aiming at increasing both the attractiveness of public transport and the service level.

> *Policy intervention in this field might be conditioned by the presence of a high quality public service or by the presence of plans to improve the overall quality of public transport.*

Policy function: to optimise the Trans European infrastructure services.

Trans European infrastructure services are crucial for the economy of the European Union and for the mobility of European citizens. The shortcomings of these services become visible when the demand for these services increases, like it is demonstrated by the road and air sector where any disturbance by accidents or whether conditions leads to important delays and costs. It is generally recognised that it is not desirable to match the growing demand in those sectors entirely by more roads or bigger airports. Considerable efforts have been undertaken to cope with the existing lack of capacity in terms of intelligent traffic management. User charges are expected to help to balance the supply and demand but the congestion problem probably cannot be solved by user charges alone (deliverable D3 indicates clearly the lack of knowledge about the real impact of these charges on the demand). The integration of information, communication and navigation technologies might be directed towards the creation of other systems and services aiming at regulating the access to the infrastructure services. Deliverable D2 outlines the lack of a framework for the application of these services. The lack of knowledge about the real impacts of user charges and the lack of framework may affect seriously the effectiveness of policy intervention.

> *Policy actions could be initiated, within the scope of article XII of the Maastricht Treaty, to develop a common architecture (in terms of available functions) and new common concepts (how to use the functions) for the management of infrastructure services. Policy intervention in the domain may be conditioned by the existence of a common policy framework about the overall management of infrastructure services, including the relationship with national and local policies.*

The communication and navigation infrastructure represents an essential support to the operators and users of transport and infrastructure services. Deliverable D4 outlines the importance of satellite based communication and navigation infrastructures and advocates the development of a dedicated European information and communication infrastructure for this purpose and a better integration of policy action plans. Deliverable D3 indicates also the need for supporting generic payment services for future development of comprehensive payment systems. The availability of these supporting infrastructures are essential to the development of new European-wide tools for the management of infrastructure services.

> *Policy actions could be initiated to come to an integrated vision on the required technical infrastructure for the integration of information, communication and navigation technologies in transport and in particular for the development and deployment of new systems for a more efficient and effective management of infrastructure services.*

Satellite based communication and navigation systems have the potential to enhance transport efficiency (and also transport safety) through the development of a wide range of new systems and services. However, the deployment of these systems and services depends on the existence of a real market.

> *Policy actions could be initiated to increase the awareness about the potential of satellite technology and to initiate policy actions to establish a real market development strategy together with the private sector.*

Policy function: to improve the efficiency of transport

The integration of information, communication and navigation technologies leads to new transport specific systems and services which enable to obtain a gain in transport efficiency. This gain can be obtained through a better co-operation between the various operators of transport services and transport infrastructure services across modes and sectors, enabled by better exchanges of information, better communication means, etc. However in a deregulated and competitive environment the willingness to co-operate is in general weak which may affect the effectiveness of the integration.

> *Policy actions could be initiated to create more incentives for co-operation between the various operators (with respect to the integration of technology) with the objective to provide seamless transport services. Another option might be to support co-operation initiatives. The policy intervention for development and deployment of those systems and services might be conditioned by the presence of minimum required levels of co-operation and firm commitments of involved operators to improve that co-operation .*

Policy function: to improve or ensure transport safety

Deliverables D2 and D4 outline the potential to develop and deploy new systems and services to improve the transport safety or to increase the capacity of transport networks without affecting the current level of safety. They also indicate that the overall responsibility for the transport safety remains with the public sector, whether transport services are provided in a competitive market environment or not. The transport industry improves continuously the safety of vehicles and the infrastructure providers continue also to increase the safety of infrastructure services. However, the resulting gains in transport safety might not lead to a significant decrease of victims: the growing demand for transport and the lack of co-responsibility of the users of infrastructure services increase the risk of accidents. Deliverable D6 shows the low level of safety of road transport compared with other modes of transport (in terms of victims). Deliverable D2 indicates that the market does not have sufficient incentives to deploy and maintain new information services for safety purposes. Deliverable D4 outlines the opportunity have a better involvement of the users of infrastructure services in surveillance and draws the attention on emerging concepts in the aviation sector which might be also applicable to other sectors (e.g. Surface Movement and Guidance Control System).

> *Policy actions could be initiated to create more incentives among the users of infrastructure services to participate in the assurance of the transport safety in particular in the road sector. Policy intervention for the integration of technology aiming at co-operation of users of infrastructure services in the safety management might be conditioned by the presence of agreements between infrastructure providers and users organisations.*

Policy function: to facilitate the integration of transport systems.

The project deliverables indicate that the integration of information, communication and navigation technologies may lead to new systems and services which are essential to the development of door-to-door transport. The expected integration of information services between transport modes and transport operators, the introduction of comprehensive payment systems and the growing communication and localisation possibilities facilitate the integration of transport systems. However, the integration of these transport systems is handicapped by the absence of incentives or willingness to co-operate.

> *Policy actions could be initiated to create incentives for more co-operation between the operators of the transport systems and to support actively initiatives for sustainable co-operation, especially in a deregulated and competitive environment. Policy intervention for the integration of technology aiming at enabling or facilitating further integration of transport systems may be conditioned by the presence of a real commitment of operators to integrate their systems. Policy actions could be also initiated to better demonstrate the strategic role and the added value of satellite based positioning and communication services for the development of integrated transport system.*

Policy function: to facilitate fair and efficient pricing

The electronic payment systems mentioned in deliverable D3 are likely to facilitate payment for a wide range of transport services. These payment systems may offer opportunities to modulate easily the price for the use of these services depending on the demand for these services and consequently to enable an efficient pricing. Comprehensive payment systems in terms of geographical coverage enable the introduction of the same pricing system in all locations of the network. Deliverable D3 indicates the need for harmonisation of pricing policies on heavy good vehicles fees which can be also seen as a condition to assure the effectiveness of the pricing policy from an overall network perspective.

> *Policy intervention for the development of comprehensive payment systems for infrastructure service pricing might be conditioned by the presence of an commonly agreed pricing policy in order to create a sustainable shift to another less congested or polluting mode.*

Identifying the policy function that the integration can fulfil constitutes the basis for the evaluation of the need for policy intervention. The importance of the policy function in terms of contribution to the achievement of the strategic objectives of the CTP and of the European Union is also a decisive element in the evaluation of the need for policy intervention. In general, the magnitude of the contribution strongly depends on the environment in which the integration takes place. Concerning this environment, the information provided in the other project deliverables enables to formulate the following remarks:

1. integrations leading to a better availability and to an improved quality of the information related to transport services and to infrastructure services are expected to change the transport system demand (change of selection of transport modes, change of period of use of transport services…). However, these changes will occur only if acceptable transport alternatives are available. Due to the numerous conditions that have to be fulfilled before to be sure that these changes will really occur, the real contribution to the strategic objectives of the European Union in general, and to those of the CTP in particular, will be probably small.
2. integrations leading to a more efficient transport or to more efficient infrastructure services are expected to contribute directly to the efficiency of transport. However, the magnitude of their contribution to the strategic objectives of the CTP will depend to a large extent on the presence of an overall policy directed towards a change in modal split. The resulting increased transport efficiency will have a positive impact on the growth within the E.U.
3. integrations leading to a decrease of incidents and accidents contribute directly to more traffic and transport safety. In general this will also be beneficial for the performance of networks which contribute to improve the efficiency of transport. The contribution of this type of integration to the growth of the European Union seems to be somewhat superior to the contribution of integrations leading directly to an increase of transport efficiency.

3.5 Operational policy requirements

In general there are all kind of barriers to the integration of information, communication and navigation technology in transport which may hinder the development of new systems and services and may delay the deployment of these systems and services. From a policy perspective, timely availability of these new systems and services is essential in order to assure an optimal support to the CTP. From a transport perspective the effectiveness of the integration is only assured if new systems become widely used within the European Union.

The synthesis of the barriers described in the project deliverables has resulted into a list of domains in which barriers can be found. These domains as well as the main barriers found in these domains are presented hereafter.

Table 4: Barriers hindering integration

Domains	Barriers
Technology	Non availability of standards, lack of interoperability, stand alone solutions, absence of integrated systems, no mature technology, insufficient infrastructure, lack of overall architecture, lack of data, persistence of obsolete standards…
Legislation	Lack of legislation (at national and European levels), privacy and confidentiality problems…
Institutional issues	Differences in national legislations, persistence of national legislations, lack of suitable platforms, institutes and centres, reluctance to transfer responsibilities to new European bodies…
Industry	Absence of industrial or commercial interest to develop new products (no commercial basis), uncertainty about benefits, industrial competition and lack of co-operation between the major stakeholders…
Financial issues	Relative short term objectives of public and private finance, lack of reliability of cost benefit ratios, balance between private and public financing, insufficient funds.
Users	Insufficient user benefits, insufficient protection of privacy, no belief in the effectiveness of new systems or services to solve the society problems, lack of awareness about the possibilities offered by the integration…
Operators	Lack of co-operation between operators especially in a deregulated and competitive environment, poor awareness about information exchange possibilities…
Market	Too weak and fragmented markets, poor incentives, insufficient leading role of the public sector, lack of powerful actors…

There are two complementary ways to deal with the barriers mentioned above. The first one consists in formulating, in an early stage, requirements in terms of conditions which have to be fulfilled in order to ensure a successful integration. The second one consists in formulating actions to overcome the barriers or to minimise their negative effects.

The synthesis of the policy requirements described in the project deliverables has led to the formulation of several operational policy requirements related to a number of general barriers which may hinder the integration of information, communication and navigation technologies in transport. The following paragraphs present the barriers and describe the rationale which has motivated the formulation of the operational policy requirements (the operational policy requirements are presented in the annex).

Standards and harmonisation

Pre-competitive standards are essential to the development of new products (systems and services) in a competitive market. The development of these standards requires in general several years and it is therefore important to recognise timely the need for new standards. The lack of harmonisation handicaps seriously the deployment of new systems and services.

High level architectures

The integration of information, communication and navigation technologies in transport requires the availability of a high level architecture which clarifies the required transport functions for new systems and services and the required interoperability between these systems and services.

User oriented approach

The integration of information, communication and navigation technologies in transport may gain in efficiency when the resulting systems and services are tailored to the needs of the users. It offers possibilities to develop commercial services and better guarantees for development of user products resulting finally in general in a more optimal support of the CTP.

Co-operative procurement

The integration of information, communication and navigation technologies in small markets is frequently handicapped by the relatively high costs for the users. Co-operative procurement may help to reduce these cost to an affordable level.

Information exchange

The integration of information, communication and navigation technologies leads to a wide range of new systems and services. The quality of these services from a European perspective depends largely on the willingness of the providers to exchange information. Despite the increasing possibilities to exchange information, the existing public services like traffic information services are still limited to a local level or sometimes to a national level. This denotes a poor interest in providing a real European service.

Information and communication infrastructure

The integration of information, communication and navigation technologies in transport requires the availability of an adequate infrastructure of basic services which will facilitate the development of new transport systems and services. Such an infrastructure however is not available today.

Legislation

The integration of information, communication and navigation technology in transport raises several legal questions with respect to privacy, payment, competition and liability. The existing laws in the Member States are not always identical due to historical reasons and there are slight differences between the way European Directives have been translated into national legislations. Most questions can be handled satisfactorily by the existing legislation however some adaptations are needed to enable or to facilitate the integration of technology. This is particular valid for new systems or services provided on a European or global scale.

In addition to the general barriers mentioned above, the synthesis has led to the identification of more specific barriers. These specific barriers are presented hereafter (the associated operational policy requirements are presented in the annex). The three first ones are related to the area of Comprehensive Payment Systems. The last one is related to the area of GNSS.

Development of remote identification of vehicles or drivers

The deployment of dynamic payment systems for tolling or road pricing is conditioned by the possibility to identify vehicles or drivers in case of non payment. The current technology consists in the identification of the number plate which contains a real risk for an erroneous identification of the vehicle. This situation represents a major handicap for the deployment of comprehensive payment systems. The use of an electronic number plate or driver licence might reduce this risk to an acceptable level.

Development of comprehensive payment systems in public transport

Currently each public transport service has its own payment system. Electronic payment means like electronic purse may facilitate the access to public transport services and can make the public services more efficient. Replacement of cash payment by electronic payment presents certainly advantages for the transport services. However this technology can become effective only it can be used to develop a system where the users are paying dynamically for the use of the service.

Standardisation of in-vehicle units and robustness of road pricing concepts

The application of a European wide pricing system for trucks transporting heavy goods asks for standardisation of the onboard units and demonstration of the robustness of the pricing system concept.

Frequency allocation and system standards

The services provided by GNSS require radio frequencies which are free from interference by other radio signals. The International Telecom Union allocates radio frequencies for various purposes. It is extremely important for the integration of this technology in transport to assure that the radio signals from GNSS are not disturbed by signals from other systems. The application of GNSS for safety critical applications requires the development of a system security approach in particular for ground areas, like airports where the satellite signals can easily and voluntary be disturbed.

The integration of GNSS in transport requires specific standards for the signals and the user products. Early development of these standards would facilitate the integration of this technology in transport and would offer opportunities for the European industry to strengthen its position in terms of knowledge.

Although presented separately, the barriers described above are often correlated. For instance, the lack of standards and the lack of sufficient market volume seem to be strongly correlated with the lack of an overall high level architecture. In the same way, the lack of an adequate technology infrastructure and the lack of adequate legal framework might also result from the lack of visibility about required functions for new systems and services (and therefore from the lack of an overall architecture).

Considering this correlation, the emphasis of the operational policy requirements might be oriented toward the availability of a commonly agreed high level architecture providing also indications about the likely concepts for the future systems and services.

This also shows that the possible correlations between barriers have to be taken into account in order to assure the overall effectiveness of policy actions.

4. Information and communication services

This chapter presents the policy requirements related to the system integration of information and communication services.

4.1 Areas for policy attention

During the project, the framework for policy assessment has been used to identify policy requirements and related policy issues. The empirical basis for the assessment is provided by a number of areas for policy attention to which real-world examples of projects, services and systems can be related. The breadth of these areas and the heterogeneity of the points of views and issues they represent are a precondition for arriving at a multiplicity of complementary policy requirements. For this reason a range of experts who represent different stakeholders and heterogeneous perspectives has made the choice[11] of the areas for policy attention. This has resulted into the selection of the twelve following areas for policy attention:

1. Dynamics in transport demand patterns
2. Use of information and communication services to influence mobility behaviour
3. Integration of information services between transport modes and operators
4. Exchange of data between different types of transport information services
5. Shared use of communication services, technologies and platforms
6. Use of Information and Communication Technologies (ICT) for transport safety
7. Use of ICT in optimisation of infrastructure use (traffic management)
8. Integration at the application level, development of commercial services and human machine interfaces
9. High level architectures and harmonisation of information services
10. Harmonisation and standardisation
11. Geographical boundaries, areas, networks etc., i.e. coverage, regions, locations
12. Implementation of policies and the timing of policy actions

These areas for policy attention address major topics that need to be considered by policy makers. The areas or topics represent different types of integration, important policy objectives and approaches for policy making and ICT-development.

For each of the twelve areas, the most relevant trends, components, issues and examples are presented in this chapter. The description of the areas for policy attention starts with the overall title and a number of important examples. The discussion of each area for policy attention is divided into three paragraphs.

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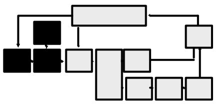
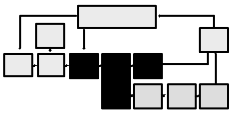
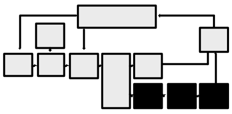
11 This has been done through a survey and through several workshops and interviews.



The first paragraph addresses steps 1, 2 and 3 of the policy assessment process (see *Figure 5*) and discusses the major trends in transport and ICT that may lead to opportunities for policy makers and the integration of new information and communication services.



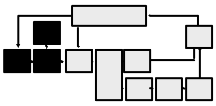
The second paragraph addresses steps 4, 5 and 6 of the policy assessment process and discusses why the area for policy attention is relevant from the point of view of European policy, in particular the CTP



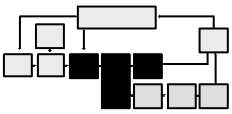
The third paragraph addresses steps 7, 8 and 9 of the policy assessment process and focuses on barriers, options and policy issues. It provides a concise overview of the most important policy options and scenarios.

4.1.1 Dynamics in transport demand patterns

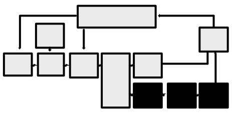
Examples: *Dynamics in Supply Chain Management and ICT (the case of freight logistics).*
Changing mobility patterns of citizens and commuters (the case of passenger transport)



The demand for transport services (flows) and traffic (capacity) is derived from the activity patterns of business organisations and citizens. New information and communication services in business and in homes will change the performance, the location and timing of activities and processes. As a consequence, ICT-development is an important driving force for future mobility patterns. Examples of new services and systems are home-shopping on Internet, tele-working, pay-per-view television, and supply chain management concepts like Efficient Consumer Response (ECR), Efficient Resource Planning (ERP) and Advanced Planning Systems (APS). The impact on mobility can be positive as well as negative. For example, forms of virtual mobility, like teleconferencing, may be considered as opportunity to prevent or reduce the need for mobility, but other researcher claim that it is substituted by mobility for other purposes. In freight transport the combination of ICT and supply chain management will open the way for advanced and real-time planning of transport operations. On the other hand, supply chain management, ERP and 'just-in-time' concepts tend to result in more frequent and long-distance transport transaction, not always easy to consolidate.



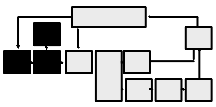
Although it is generally known, that the demand for transport services (flows) and traffic (capacity) is derived from the activity patterns of firms and individuals, the consequences of the relationship between (economic) activities and mobility are in many cases overlooked and underestimated in transport policy. The drivers and processes in these activity patterns may overrule the impact of transport policy actions. An intelligent transport policy has to deal with this relationship in an appropriate way. Since the transport behaviour of users (business organizations and citizens) is explained by the organisation, management and planning of activities on the one hand, and the availability of transport services and capacity on the other hand, there is a need for more insight in the relationship between activity patterns, the need for mobility and the impact of ICT-developments on business and society as well as on transportation. Especially for investments in TEN's and related IT services is it important to take the dynamics of activity patterns into account. The development of IT-services related to supply chain management is predominantly driven by multi-national companies, which makes a European approach more effective. To fully exploit the opportunities of new IT based concepts for the redesign of transport patterns, there is a need for a policy addressing more actively the opportunities to integrate transport into the newly developed IT-based business concepts.



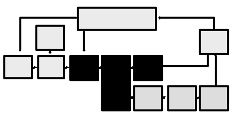
Since the dynamics are primarily driven by the private sector, not involved in transport directly, the main focus of policymakers should be devoted to monitoring of trends. From the point of view of TRANSINPOL, identification of new ICT-related business concepts and the impacts on mobility patterns is the most important. These trends are relevant if they lead to a demand of mobility for which the capacity is not available. If transport capacity is not available the simple solution is to accommodate, i.e. implement new transport services and/or build new infrastructure. ICT-integration can be a crucial strategy for policy options to optimise, transform or reduce transport flows. A number of the TT-services identified in TRANSINPOL have the opportunity to establish an intelligent link between transport demand and capacity, stimulating optimisation required for both individuals and the society (in line with the CTP).

4.1.2 Use of information and communication services to influence behaviour

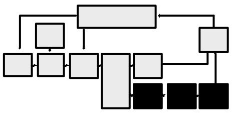
Examples: *Transparent and open market information services.*
A policy on pricing and service quality, reflecting scarcity in transport provision.



Market information services contribute to transparency in demand and supply of transport services. Transparency improves individual users' choices and the quality of the transport services, because it influences choices on mode, routes, operators and time. Forwarders and travel agencies traditionally perform the role of market information services. Technological developments enable the provision and use of information to be dynamic and location-independent, allowing decisions based on the actual status/situation and the availability of transport services. In addition, monitoring and planning through advanced ICT can support price differentiation to reflect scarcity. This would further raise the effectiveness of the market information systems and will improve the utilisation of the transport system through a better tuning between transport demand and supply, i.e. resource management.



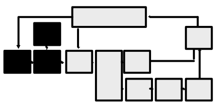
Transparent market information services are an essential precondition for an optimal transport market, leading toward more sustainable transport and more intermodality. On the one hand, it will enlarge awareness of the opportunities of (intermodal) transport, on the other hand, it will spread demand more evenly over the available (intermodal) transport capacity. The effectiveness of market information services strongly depends on the level of transparency it creates, which is a function of openness and neutrality of the TT-services. Open market information services can bring transport services at the required scale and scope and stimulates competition on the transport market. Sufficient scale and scope is a necessity to establish intermodal transport. From a policy point of view, the effectiveness can be enlarged if the selection criteria for the shipper or travellers, either in price or service quality, also reflect societal goals. Examples are dynamic (infrastructure) pricing and yield management, offering opportunities of allocation by the market of the available capacity and a spread in peak demands.



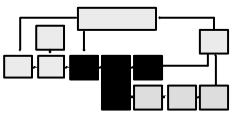
The provision of market information services is predominantly a task of the private sector, i.e. transport operators or IT-service providers. A major organisational barrier is that in particular competing transport operators are unwilling and have no incentives to co-operate in establishing market information systems. An other barrier may be the fact that transport services are not always as user oriented as they should be (see section 4.1.7) The public sector can support the market information services by stressing the benefits, through analysing business opportunities, business models and barriers. Information services providers outside the transport sector, exploiting IT services, like electronic publishers, could be neutral parties to safeguard competition and to discard possible barriers related to co-operation with competitors. In parts of the passenger transport, the public sector is already involved in the provision of services, because of the public and collective characteristic of public transport. This has lead to open systems (accessible for everyone) at a large scale and with great effectiveness.

4.1.3 Integration of information services between transport modes and operators

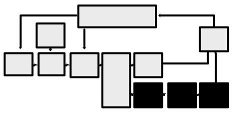
Examples: *Transfer of services like Computerised Reservation Systems (CRS) in air transport to other modes or between modes at the multimodal interfaces.*
ICT to establish seamless transport between different transport partners.



ICT-systems and services are an important enabler for co-operation between transport operators within a mode or between modes in interoperable transport services. Apart from market information, it will require exchange of information on shared use of resources and equipment, improved planning by early availability of information and/or on the realisation of a seamless transport service within a transport network.



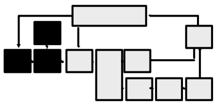
Integration of information and communication services of different modes and operators, provides opportunities for efficiency and sustainability by higher utilisation of transport capacity and on the other hand contributes to higher quality of transport services to users by realisation of integrated transport services. It is also a key condition to the realisation of large-scale public transport and intermodal transport. Only through co-operation can a service quality comparable to direct road transport be achieved, and can transport flows be consolidated or bundled. Public as well as intermodal transport requires large volumes of transport. TT-services are essential to organise that. In a competitive and fragmented transport market, it is difficult for individual operators to start and to establish (wide-scale) co-operation because of the lack of a powerful actor or problem owner and the interdependencies leading to prisoner dilemmas.



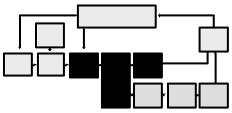
Co-operation and integration of services and operation again is primarily a task of the private sector. Good framework conditions and financial support of initiatives for new co-operation seems to be the major road to go, for instance through R&D, communication platforms, or pilots projects. Important issue in case of co-operation between operators within a mode is a balance between co-operation and competition, concerning pricing and monopolies in capacity. The latter, being so important, because in terms of geographical relations and nature of transport services, transportation is characterised by many market-niches. The provisions of co-operation facilitators can give support and guidance. These are neutral third party that identifies opportunities for co-operation, assesses the scope for co-operation, initiates and manages the co-operation building process. Also methodologies can be provided for the accommodation of interests in co-operative ventures.

4.1.4 Exchange of data between different types of transport services

Examples: *Navigation and traffic management information used for tracking and tracing services, i.e. TT-service on operation management. Information of operations management also used in services for dangerous goods and vice versa.*

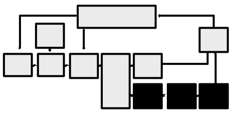


The basic issue is making use of the added value of available information. Many times people or organisations are not aware of the value of their information to others. In most cases TT-services support different transport actors and markets, focussing on different stages of the transport operation. However they are all part of a single system designated to the transport of goods or passengers in an efficient and safe way. The TRANSINPOL-study encountered many cases where, from a holistic perspective, there are significant opportunities for improvement for each of the actors and markets, if information is exchanged between the different layers and between public and private actors. In fact, all data used by the variety of actors and included in different types of services, consists of a limited set of data items (like origin, destination, vehicle, etc). Data available in information systems of logistics service providers and transport operators is valuable information for dangerous goods services and statistics. Information of navigation systems and traffic management provides information on actual position of vehicles relevant for the logistic optimisation of the transport operation, but even valuable for the final users, i.e. passengers and shippers. One of the obvious solutions here is data warehousing. However, many cases illustrate, that the complexity of transport makes this technical difficult, if not impossible. Moreover, central databases seem to be threatening in the competitive, commercial transport markets. An alternative, tested in several recent systems is based on distributed databases and software agents. Identification numbers can establish links between databases, for instance for transport transactions during their life-time from initial information and order till finally invoicing and statistics. The major barrier is to get an agreement on such unique ID's and also get them implemented in the databases of the major actors. Apart from being technical advanced, the organisational advantages of these concepts fit very well in the transportation market. For instance privacy issues can be solved if actors remain in control of their own data, which can be done technically in such systems.



The public sector has a key position in the process to stimulate the exchange of data between different types of information services, since it has an overview of actors and processes. Moreover, much data is stored in public databases, or may also have application to public services. Apart from the co-ordination to establish links between the several organisations involved, the exchange of (public as well as private) data between different types of services, requires co-ordination with respect to harmonisation of terminology, formats and technologies.

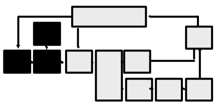
The exchange of data contributes to the realisation of the CTP-objectives of efficiency and safety (see section 4.1.4). In case of safety, it does not only facilitate the provision of information to dangerous goods information services, but also improves the quality and accuracy of data, for instance to perform market and policy analyses.



The identification of opportunities for exchange of data, the creation of incentives to start the exchange of data and the realisation of interconnectivity are important success factors. Research and development can create awareness of opportunities, the public sector can give a major incentive to this process, since it is one of the large actors (i.e. traffic management, dangerous goods). Important barriers and policy issues are privacy and the use of public data[12]. In general public funded pilots may lead to dissemination of the lessons learned in the most difficult part, the organisational implementation within chains and networks. As a by-product of these pilots development will take place, that is needed in every specific case of integration. Adaptations, system integrations and conversions will be needed at the several interfaces.

4.1.5 Shared use of communications services, technologies and platforms

Examples: *Generic, universal TT services in different modes, use of non-transport services*

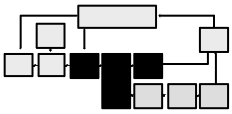


During the TRANSINPOL research it became evident that actual technical systems and communication platforms “behind” the TT-services, were in most cases not geared to transport operations or transport policy. This is not astonishing since transportation is only a minor part of the overall IT-market (less than 10%), while the pace of developments in ICT is much higher as in transport. Platforms like GSM, the Personal Computer and Internet have developed during the last decade, almost totally independent from transport requirements or consequences. Many examples illustrate that the selection of technology and platforms may have a major influence on the development and adoption of new services by transport actors. For the transport sector it is beneficial to base new services and systems on existing generic services, technologies and platforms. Information services using the same communication services, technologies and platforms are less costly to users, since users only have to invest in a single system. This will provide economies of

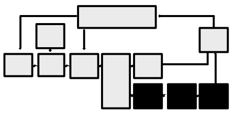
[12] Harmsen, D.-M., Matuschewski, A. (1999), Policy Issues for the integration of information and communication technology in the transport sector, working document, TRANSINPOL, Fraunhofer Gesellschaft.

scale to technology and communication service providers. Transport services, combined with non-transport services may also have great advantages from the point of view of the users and the commercial exploitation (see section 4.1.8).

Still, in a number of cases the requirements of the transport sector should be taken into account in the development of new technologies and services developed by the IT industry. TRANSINPOL has shown that there is a large degree of communality in the various transport markets and modes, allowing to create scale within the transport sector and to facilitate co-operative procurement. Stimulating such platforms to get co-operative procurement can be a task of the European Union, certainly for modes and services where a European scale seems to be obvious, like the TEN’s or even public transport in cities.



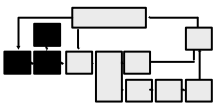
Facilitating and stimulating co-operative procurement and exchange of knowledge of technical issues between modes and services is a task for the European Union since it includes all modes, services and Member States. It is important for the deployment of transport information services in general to ensure low costs of information services.



To obtain scale on the demand and supply side, universal concepts need to be defined for (each of the) transport telematic services. The concepts can then be broken down into transport sector requirements for communication services, technologies and platforms. Co-ordination activities and R&D initiated by the European Union, should focus on identification of the functional and technical similarities in services, within and between modes (see also section 4.1.9 on architecture). More transparency could lead either to more aggressive sales behaviour of individual suppliers or of alliances between suppliers in order to harmonise their products and achieve wider market coverage.

4.1.6 Use of Information and Communication Technology for Transport Safety

Examples: *Navigation, Infrastructure management (signalling), Incident management & dangerous goods, Back-up systems and contingency plans*

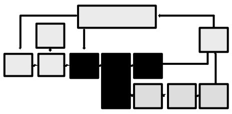


The three major objectives of the CTP are efficiency, sustainability and safety. As has been illustrated in the earlier sections the two first objectives can in many cases be achieved through a certain guidance of market forces. Safety, in contrast, has to be enforced in most circumstances. Moreover it requires world wide, or at least European standards. Costs for TT-services purely for safety reasons are in most cases without any doubt public, or at least collective. For the subject of TRANSINPOL major relationships with safety can be found in:

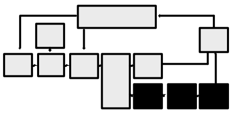
- navigation, traffic management, positioning (GPS/GNSS) and (digital) maps,
- safety services, like incident-management and dangerous goods information systems and emergency and distress systems,
- user-environment of information services and their user interfaces, terminology and interoperability.

- contingency plans, not only dealing with safety directly, but also with risk management dealing with the crucial position of transportation in the society

Market forces drive navigation services and positioning services, although traditionally these were public services for instance in the maritime sector. From a policy perspective it is important to ensure that these systems have sufficient and similar accuracy, adopt guaranteed levels of reliability, and use the same reference systems. Emergency services should have access to all relevant and accurate information on accidents, vehicles and shipments and to communications services. The use of information and communication services may not lead to dangerous situations and should be easy to use and recognise in case of emergencies. These requirements apply for all modes and member states and thus have important consequences in terms of standardisation (see section 4.1.10) and concerning the exchange of data between services (see section 4.1.4).



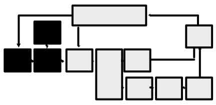
Traditionally, safety is a task of the public sector. European-wide implementations of large-scale systems such as the European Air Traffic Management System, a maritime information system for dangerous goods or the European Rail Traffic Management System are at different stages of implementation. In road transport implementation of infrastructure-related systems (sensing, variable message signs) varies locally and nationally depending on the traffic situation and the importance attributed to road safety. On-board components are available to who is prepared to pay for it. There is still no European-wide agreement on a common architecture for road traffic management systems (infrastructure of vehicle based). The policy involvement of the European Union in the area of navigation, positioning and digital maps concerns the minimum requirements of technologies and services (reliability, accuracy, back-up systems) and the design and tests of user interfaces. Evidence of several cases analysed in TRANSINPOL suggest that from the point of view of transport safety, in particular for modes involved in international transport, the emphasis should be on these human machine interfaces, including dictionaries and symbols/icons used (see also section 4.1.8 and 4.1.10). Agreement on these interfaces, in particular those used by drivers of vehicles, is required from the point of view of safety, but will also be beneficiary to the IT industry. This will give the IT industry clear framework conditions and in addition a maximum of freedom to develop and exploit systems behind the user interfaces. In air and maritime transport, which are global businesses, it is a task of the European Union to co-ordinate the requirements and to represent the European Union in international committees and institutions. Dangerous goods systems, incident management systems, contingency plans and emergency services, serve primarily the public interest. Especially for intermodality, the harmonisation of classifications and terminology in the different modes is required.



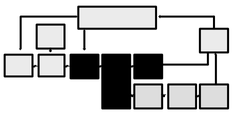
Subsidiarity is not always effective, because this may result in differences in information, formats and technical systems in the different Member States. On the other hand, it may be more time-effective. Promotion of non-safety critical applications of ICT in transport by making the enabling technology a requirement for a safety-critical application (e. g. tagging of containers). International negotiations on safety standards. Definition of minimum requirements for safety-critical systems. Definition of European-wide inter-operability requirements for safety-critical systems and the withdrawal of financial support (also nationally) from advanced technologies in the safety domain to enable a market selection of a European architecture.

4.1.7 Use of ICT in optimisation of infrastructure use (Traffic Management)

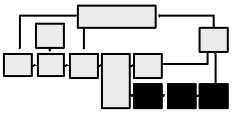
Examples: *Real time and dynamic information for traffic and travel management.*
Opportunities, impacts and user acceptance of infrastructure payment, slot management and pricing of traffic and travel information.
Road pricing.



Information and communication services enable infrastructure authorities to co-ordinate more actively the allocation and use of scarce infrastructure capacity. In the near future, traffic management in terms of the basic mechanisms of self-regulation by information, direct regulation and control of traffic flows and pricing can be made much more effective. This will be relevant especially in air and road transport. For all three mechanisms holds that dynamic data, and the identification of and communication with individual traffic-participants (drivers), increases the opportunities to optimise, spread and allocate the available infrastructure capacity. Pricing, traffic regulations and capacity allocation means that implicitly or explicitly different user groups are or can be distinguished (freight traffic, commuters, local or transit traffic, leisure, business travellers). The combination of yield management and the identification of different user groups (user profiles) makes it possible to use differentiated pricing schemes and to maximise revenues to cover the investments in infrastructure. Yield management could be successful for financing of new infrastructure by public as well as private actors.



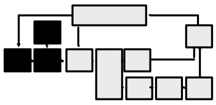
(Dynamic) traffic management and infrastructure (road) pricing are the areas in which direct involvement of the public sector (in its role as infrastructure provider) and transport policy (in order to guide mobility) is evident. These areas form the centre of recent developments in the application of information technology to transport with many successful implementations, especially in road transport. The next step in deployment is to optimise the use these services on the level of transport systems, focusing on the one hand on the maximisation of capacity use and on the other hand on ensuring the mobility of different user groups. In road pricing and slot and yield management, the height of tariffs and their differentiation have impacts on socio-economic variables and competitive position of regions and business organisations. It is important to estimate the effectiveness and socio-economic impacts of the different pricing schemes. Furthermore, an integrated transport system requires a set of mechanisms and instruments that realises a good balance between modal split objectives, recovery of investments in infrastructure, congestion and mobility needs of economic and non-economic traffic. From the point of view of the objective of sustainability, internalisation of external costs of transport can also be realised by means of infrastructure pricing. The relevance to the European Union lies in the pricing schemes and socio-economic and regional economic impacts. There is a need for policy to define a framework indicating how the various instruments should be applied. This framework should consider the requirements and priorities between different user groups taking into account transport efficiency and economic and socio-economic issues and impacts.



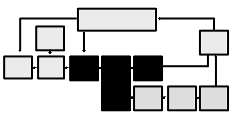
Given the promising take off of new services and systems for traffic management, it is important to continue along these lines of development and to co-ordinate the developments in several regions and modes, to ensure that the most promising components are taken on board. This is in particular relevant for the exchange of knowledge between modes, since evidence in TRANSINPOL shows that from the point of view of IT there are many similarities in technologies and concepts for the distinctive transport modes. In defining the framework for traffic management, the issues of user acceptance, a common European pricing scheme, technology requirements and law enforcement's should be considered. Furthermore, policy should also take into account the link between traffic management and the optimisation of transport planning (see section 4.1.2 with yield management as an example), or even supply chain management (see section 4.1.1). If traffic management is also based on slot management and infrastructure pricing, traffic management has indeed the potential to establish the link between several market layers in the scheme. However, regional differences in infrastructure use, economic dependence on infrastructure and welfare lead to different opinions concerning the usefulness of infrastructure pricing and for what purposes one should spend the incomes.

4.1.8 Integration at the application level, development of commercial services and human machine interface

Examples: *User approach in development of Transport Telematic Services (HMI, integration of public and private services).*
Exploitation of public available data for instance by providing individualized (tailor-made) information.

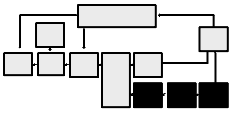


Often, the integration of information technology and service is technology push. Although it is argued that information must be valuable to a user, the situation or context determines the perceived value by the user. Important for the user is the prime function to him, how this information is presented and how it is related or integrated with other activities and services relevant to the user. Parallel to trends of mass-individualisation and customer-value in supply chain management, a real user-oriented approach in the development of information services, starts with specifying the value created to the customer, i.e. the usefulness of the system. This is also true in passenger transport. The customer-driven approach provides opportunities to exploit commercial transport information services, since users will be willing to pay for real value. Also public data and publicly owned information and communication services have value to actors. Traffic data is not only valuable for the provision of traffic information, but can also be valuable for tracking and tracing of goods and vehicles. There are almost endless opportunities to combine information in order to create additional value for the user



Main problem is that transport actors as well as IT service providers do not always sufficiently realize that the provision of services is more successful if it is user-driven. Intervention by public actors can aim to ensure effectiveness of transport information services contributing to efficient, safe and sustainable transport. The purpose of public intervention can also be to protect the user against a multiplicity of services, basically having a similar function. Stimulating involvement of consumers' representatives in an early stage of development may can avoid user-equipment with only a marginal value.

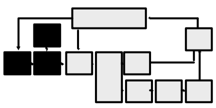
Additionally, the user-oriented approach may provide the public sector with opportunities to integrate public functions, for which the user basically is not willing to pay. That is the case for functions which have no direct added value to the user, but are beneficial to the transport system from a public perspective. Creating a combination with a profitable service and not-profitable service can be called 'the strategy of the Trojan horse'. The obvious example is road tolling integrated with traffic information, navigation systems and other payment systems. In that example the negative connotation of the Trojan horse is evident, since people are not willing to invest in road payment devices, until they are forced to. However in other cases, the strategy will support a system or service with a number of functionalities, each of them not being able to motivate the investment on its own.



A first policy option here is to emphasise the need for a user-oriented approach[13]. The public sector has the option to support research into user-oriented services and integration of user-equipment of different types of services. Use of already widespread devices (e.g. mobile phones) as front-ends for new services may support the take off and stimulate growth to a wide scale use. Secondly, specific attention will be required for interfacing, as the disconnecting point between several systems and services. This will stimulate all kinds of new applications, where public-private combinations might have surprising results through the 'Trojan horse' strategy. To this end, attention is needed on functional integration through good descriptions of architectures, opportunities for standards or conversions at these interfaces and not at least the human machine interface.

4.1.9 High level architectures and harmonisation of information services

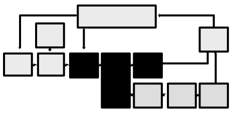
Examples: *Use of high level models to stimulate communication in a user oriented research and development.*
Generic design and best practice models for universal TT-services.



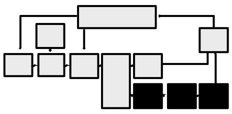
An architecture provides overall guidance to ensure the interoperability and compatibility of system and products without limiting the design options of the stakeholders/suppliers. An architecture provides a common structure for the design (functions, elements and terminology) of transport information services. It is neither a system design, nor a design. A commonly accepted architecture of information services facilitates the realisation of interoperability of services in the long run and has a stimulating effect on market developments since it provides clarity on the meaning of functions and how they are interrelated.

[13] Harmsen, D.-M., Matuschewski, A. (1999), Policy Issues for the integration of information and communication technology in the transport sector, working document, TRANSINPOL, Fraunhofer Gesellschaft.

The development of an architecture is most of all a process in which all actors, i.e. the transport sector, IT-service providers and IT-industry are involved. In such a multi-actor discussion, confirmation and support is created for a framework in which development of information services in the future will be established. Principles are self-regulation and co-ordination through agreement on common interests.



The interest of the European Union is to realise interoperability of services and systems in the distinctive transport modes and Member States (in the long term). Interoperability determines for large parts the size of the contribution of ICT to the CTP, in particular where scale is prohibitive for the development. The contribution to the CTP is in many cases only indirect. The border crossing nature of transport and in information and communication services means that the European Union has to play an important role. The development of architectures has already started with projects like CONVERGE, KAREN, ARTEMIS, INTACT and COMETA. Architectures are of significant importance to the integration of information services between transport modes and transport operators (see 4.1.3), the exchange of data between different types of transport information services (see 4.1.4) and shared use of communication services, technologies and platforms (see section 4.1.5). Common architectures have to cater for a wide range of functions and elements, knowledge of which can only be achieved from a holistic perspective, which is often difficult to obtain. The balance between the taking into account of very specific functions and elements and the proliferation of the complexity of an architecture may be difficult to strike. There may be a danger that competing architectures emerge and the interoperability problem is simply moved to a higher level.

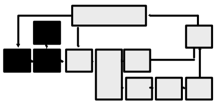


There is a need to check if the functionality and elements of a planned TT-service conforms to current and future demands for interconnectivity and interoperability between services and systems. The main task of the European Union is to initiate and to co-ordinate the process of the definition of architectures and bringing together the various stakeholders (transport sector, public sector, service providers and IT-industry). In later stages, dissemination of architectures and support to stakeholders in the deployment of the architectures becomes important. Although the development of architectures is in the interest of all actors, a barrier may be that not all actors may be willing to participate because there are no direct benefits to them in the short run. Research and Development activities (also within the various Framework Programmes) are appropriate instruments. A strategy for the development of architectures is to start from small-scale and successful services and systems (best practices) and to have them transformed into generic elements. So, the process of defining architectures does not become an academic activity, but is closely related to practice. Attention should be paid to the risks threatening architecture. It should be noted that the development of architectures is an enormous and on-going task. An example of the effort that is required, are the United States, were ITS and the Department of Transport allocate substantial resources to the development and deployment of the national ITS architecture.[14]

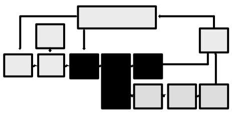
[14] Intelligent Transport Systems, National ITS Architecture documents, http://www.itsa.org/archdocs.nsf

4.1.10 Harmonisation and standardisation

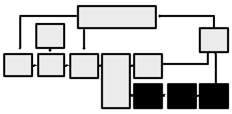
Examples: *Is standardisation aiming at safety and user convenience and/or interoperability and techno-economic scale?*
Co-operative procurement enlarging demand and supply of ICT-systems



"People should first talk the same language (= architecture), but interoperability does not exist until physical systems talk together"[15]. Standardisation or at least harmonisation is an important issue. The harmonisation can be focused on the user interface and on the technology comprising the system. From a transport perspective, technical harmonisation facilitates the connectivity of information systems of different actors. Common protocols, data formats and interfaces are developed to ensure the smooth exchange of information. It also enables the use of information services, systems and equipment in other Member states. Furthermore, technical harmonisation has a close relationship with competition in services and technologies. Harmonisation leads to an increase in competition in the supply of services and equipment and it generally results in lower costs and force suppliers to become more creative and user oriented. The harmonisation of user interfaces facilitates the easiness of using services in foreign countries or to become familiar with new services more quickly.



From a CTP perspective there is no direct interest for the European Union to strive for technical harmonisation. The relation between the CTP and harmonisation is indirect. Technologies and services should be left to market competition as much as possible. However, standardisation is also an appropriate strategy to increase the size of the market for services and technologies and to reduce costs of technologies/equipment by realising economies of scale. Interoperability of cross border links is a specific case here, that indeed may be motivated by an open market and a level playing field all over Europe. Therefore, there is a need to assess the development of services and technologies from a CTP perspective, i.e. to evaluate which services and technologies have the potential for large contribution to the CTP but show a fragmented market on the supply side.

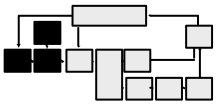


Standardisation or harmonisation is a difficult task. It is time consuming because it is generally based on agreements and developments in which strong industrial forces are involved. It is also very expensive to replace or adjust existing systems. However, actions to initiate and co-ordinate the process of harmonisation and standardisation need to be defined by the European Union. By broadening the scope of standard committees all potential intermodal and interoperable aspects may be taken into account.

[15] Remark made by a respondent of the TRANSINPOL survey

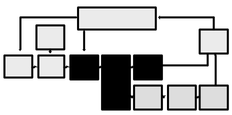
4.1.11 Geographical boundaries, areas, networks etc. (coverage, regions, locations)

Examples: *A global approach is particularly relevant for global modes like maritime and aviation, but also for global systems like GPS and GNSS.*
TENS: missing links, peripheral regions and interoperability.

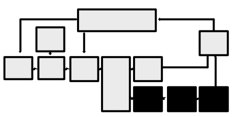


ICT development and the activity patterns of citizens and business organisations like supply chain management globalises. Information technology enables the control of operations to take place over larger distances and activities to become footloose. This flexibility creates regional competition since businesses can be located anywhere. This provides opportunities for peripheral regions and the accession countries of the European Union. These regions can profit from the rapid pace of development of information and communication services. Hence, one should be aware of the fact that the generic economic law is ‘economies of scale’, i.e. organizational as well as geographic concentration.

Another geographical element is the development of services on a local or urban level, for instance services for public transport and traffic management. At various places in the European Union, new services and concepts are developed and implemented, raising the issue of the development of standardised systems and services for local services.



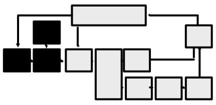
Policy can make use of the rapid development of information technology and should stimulate the deployment of the latest technologies and services in peripheral regions. However, this should be considered parallel to structural improvement of other business requirements like the availability or development of transport services and transport infrastructure (TEN’s). Developments in the European Union may be hindered by the fact that air and maritime transport are global businesses in which it difficult to make serious progress without full co-operation and agreement of other states. For local services, a fully standardised approach is not necessary from a user point of view. Regular travellers will become accustomed to specific services, and tourists, too, may adapt to the local situation. Interoperability throughout Europe for local services is not so much a user requirement but a political issue and a facilitator for efficiencies of scale.



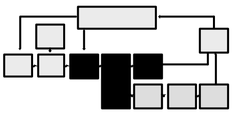
To stimulate the development and deployment of information and communication services across the European Union and in the accession countries, exchange of knowledge and expertise is crucial. The European Union already initiated Technology transfer programs (PHARE for Eastern Europe). Integration of services in urban areas (traffic management, public transport) is also an area that is relevant for the exchange of knowledge and experiences, although the establishment of a common approach should not be an objective on its own. Convergence over time may be expected anyway.

4.1.12 Implementation of policies and the timing of policy actions

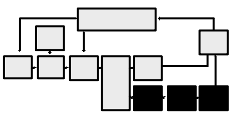
Examples: *New infrastructure is a long term solution to deal with congestion, being a short term phenomena.*
A 24-hour economy will lead to a higher utilisation of transport capacity.
Dealing with the contrast between standards and large scale solutions versus flexibility in the use of capacity and flexibility in future innovation.



A structural change or improvement of the transport system takes time. An intervention in the functioning of markets (e.g. deregulation or liberalisation) means that all actors have to change their behaviour and get accustomed with a new set of rules. Investments in new infrastructure have proven to be time consuming. Transport systems change relatively slowly compared to the developments in information and communication technology and changes in society. ICT may support the process of establishing structural changes in transport and add some flexibility to the planning process of investments in transport capacity. Generally speaking, ICT is capable of improving the utilisation of available transport capacity. Because transport is a service, transport capacity is normally tuned to the peak requirements of the system, this means that large parts of the day (week or year) there is slack capacity. The integration of ICT focusing on the shift of peak demands to the enormous slack capacity in transport and of infrastructure is a great opportunity. This relieves the need for further expansion of infrastructure capacity, the 24-hour economy being one of the components.



In defining policies, policy makers should take into account the differences in the time frames of policy implementation. Information and communication technologies can be a tool to solve problems or bottlenecks more quickly or at least to serve as a temporary solution until more structural and time consuming measures are implemented. The fast pace of development in the information and communication technologies means that also the process of policy making should be relatively quick and address and capture in a short period the opportunities offered. In case of large-scale services and systems at the European level (for example for safety and interoperability), it will be difficult to maintain flexibility and to take into account new developments and changes during the process. However, since structural changes or extensions of transport capacity will remain necessary, policy should specifically address the balance between short-term measures supported by ICT and the long-term solutions.



The high pace of development makes a good timing of policy actions difficult. Effectiveness of policy actions aimed at the development and deployment depend strongly on the ICT capabilities of the market (i.e. is one ready to adopt a new service and/or is the technology mature?) and the level of uncertainty to the market (i.e. if there is no standard technology, little progress will be realised). Therefore, it is important to analyse to what extent and at what time scale ICT-solutions can be implemented.

4.2 Policy Requirements

The policy requirements associated to the areas for policy attention described in the previous sections are given hereafter.

Explore and monitor the consequences on transport demand of the integration of ICT in the society

There are major developments of ICT taking place outside the transport sector. Once integrated into transport these developments may have large impacts, also on transport demand patterns.

Policy makers in transport need to identify and address more actively the opportunities to integrate transport into the processes and operations that make use of advanced ICT. Policy should especially emphasise the opportunities of improved transport efficiency through application of advanced ICT in the activities of companies and citizens.

Establish a framework for the changing of mobility behaviour in line with the objectives of the CTP

ICT enables the introduction of dynamic and customised information and pricing services. The match of supply and demand of transport services can be improved and can increase efficiency in transport.

There is a need for the development of a framework in which the basic principles of dynamic information and pricing are defined and its social implications and the technological requirements are explored in order to support European-wide introduction and deployment.

Integrate information services between transport modes and transport operators

The area indicates that information and communication services are an important enabler to establish co-operation between transport operators to realise seam less transport services within transport networks.

There is need for policy to create incentives or support initiatives for co-operation between operators, especially in a deregulated and competitive environment. The integration of information services is not the only objective here, but also an enlarged synergy and interoperability between the several transport services themselves.

Promote efficient data exchange and data sharing between transport information services

The area indicates that there are opportunities to increase the efficiency and effectiveness of processes in the entire transport sector if seemingly unrelated services exchange data.

Fear for loss of commercial control and privacy, but lack of understanding of the value of data, leads to fragmentation. Also in the area of data-sharing policy makers need to create awareness that these opportunities exist and the drawbacks can be overcome, through creating incentives for the exchange of data or integration of services.

Make the ICT-supplier base to transport more responsive and more efficient

Technology in itself is not an issue form CTP perspective. The IT-industry is generally well capable of providing appropriate technologies and products. Since developments in the IT-industry have a faster pace as in the transport-industry, while transport is only a minor market for them, the transport sector normally will have to follow and be aware of the opportunities. However, there are services and technologies for which it is cost-effective to have a single solution or option. So, there is a need for a policy to identify the services and products that are specific for transport. Specification of requirements for the transport sector, maybe even co-operative procurement, will lead to co-ordination and putting transportation on the agenda of IT-providers. This will also lead to significant cost reduction for the end-users and support European industry.

Define ICT-related transport safety requirements

TT-services can contribute significantly to transport safety, but generally the market does not have sufficient incentives to deploy and maintain these services themselves.

In a free market there is a need to define the minimum (transport) safety requirements to which information services should apply. These requirements should focus on availability and accuracy of information, service reliability and a safe user-environment. The development and deployment of transport safety, dangerous goods information and incident management services remain a responsibility of the public sector.

Promote a better use of infrastructure through traffic management for all modes

For all modes, R&D efforts have resulted in a large range of ICT instruments to support traffic management. By means of ICT, infrastructure operators have increased opportunities to apply traffic regulations, pricing and capacity allocation.

There is a need for policy to define a framework indicating how these instruments should be applied. This framework should consider the requirements and priorities to different user groups, transport efficiency and economic and socio-economic issues and impacts.

Promote user-orientation through commercial services and well defined user-interfaces

A user oriented approach in the development of information and communication services increases the effectiveness of these services and its deployment process. It offers opportunities for the provision of commercial services and for combination of profitable services with non-profitable services that are beneficial from a CTP perspective. Politicians should be aware of the creative opportunities to combine user devices where non-transport and transport functionalities are integrated in a commercial environment.

Policy should create awareness among information providers that a more user-oriented approach is required and co-ordinate activities within the transport to define.

Support the definition of high-level architectures (TT-system functionality)

A commonly accepted architecture of information services facilitates the realisation of interoperability of services in the long run and has a stimulating effect on market developments since it provides clarity to all stakeholders on the meaning of functions, terminology and elements and how they are interrelated.

The European Union should support the development of architectures in all modes and for all services and disseminate the knowledge and architectures that have been developed in road transport to other modes. This will also enable the debate on common objectives. Specification of modular reference models, with an emphasis on primary functions of Transport Telematic Services (TT-services) and subsequent interfaces, will simplify standardisation and prevent blockades in innovation.

Support harmonisation and standardisation (interoperability of technical TT-systems, messages and terminology)

Harmonisation and standardisation of technologies and products facilitate interoperability and deployment of information and communication services. They enlarge the market for IT–products and technologies and stimulate competition in the supply of these products and technologies (lower costs).

Firstly, there is a need to assess the development and provision of services and technologies from a Common Transport Policy perspective, i.e. to evaluate which services and technologies have the potential for large contributions to the CTP but show a fragmented market on the supply side. Secondly, actions are necessary to initiate and co-ordinate the process of harmonisation and standardisation. In a fast developing world support of de-facto standards may be one solution.

Promote technology transfer between regions and define the major European nodes and links

The development of ICT and, as a result, the activity patterns of citizens and companies are no longer restrained by geographical boundaries. This provides opportunities for peripheral regions and the accession countries of the European Union to attract new business.

Policy can make use of the rapid development of information technology and should stimulate the deployment of the latest technologies and services in peripheral regions. However, this should be considered parallel to structural improvement and business requirements in the major European networks, like the availability or development of advanced transport services and ICT/transport infrastructure at the most important nodes and links (TEN's).

Stimulate the implementation of policies and the timing of policy actions.

The time frames of developments in ICT differ strongly from the time frames of structural changes in transport markets and the development of physical transport infrastructure. Development and integration of ICT are very fast compared to the dynamics in the transport sector. Although ICT is not a panacea for all problems, it may be a means to solve problems and bottlenecks more quickly or at least serve as a temporary solution until more structural and time consuming measures are implemented.

Policy should specifically address the balance between short term measures supported by ICT and long term solutions in terms of market structure and infrastructure investment and should also address the opportunities of ICT to facilitate structural changes in transport. Finally the speed of implementation of ICT in the transport organisation, to facilitate structural changes in transport and achieve a sufficient scale of application, requires additional stimulants.

5. Comprehensive payment systems

This chapter presents the policy requirements related to the integration of Comprehensive payment systems in the transport sector.

5.1 Definitions and scope

The term "Comprehensive payment systems" is defined as "*ICT-based systems covering several geographical areas, several transport modes or several service sectors, and whose primary function is to enable the user of a service to pay for this service, using electronic means*" and the term "electronic payment services" is used to designate specific services available within the area of comprehensive payments systems.

The research performed during the project showed that the conditions for large-scale introduction of electronic payment were only found in some specific areas of transport:

- Road usage,
- Passenger services (mainly bus/train, short distance rail and ferries),
- Car parking,
- Transport information services.

As large-scale introduction of electronic payment is a prerequisite for any significant contribution to the objectives set by the Common Transport Policy, these areas are also the only areas in which policy requirements have been formulated.

5.2 Comprehensive payment systems and policy

5.2.1 Payment services

In order to identify all the opportunities and perspectives available in the area of Comprehensive payment systems, scenarios of the "best possible future" have been developed in the areas of short distance car transport, long distance car transport, public transport, and Heavy Good Vehicle (HGV) transport.

Based on these scenarios a list of prospective electronic payment services has been identified, describing the services that are found to have a potential for a positive contribution to the fulfilment of the objectives of the Common Transport Policy. The identified services can be divided into two types of services.

The first type of services corresponds to services directly needed by the end users (e.g. payment services for parking, for collective transport…): they are called **primary payment services.**

The second type of services corresponds to services related to overall financial systems[16] and enabling the primary services to work: they are called **supportive payment services**. The following table presents the identified primary and supportive payment services[17].

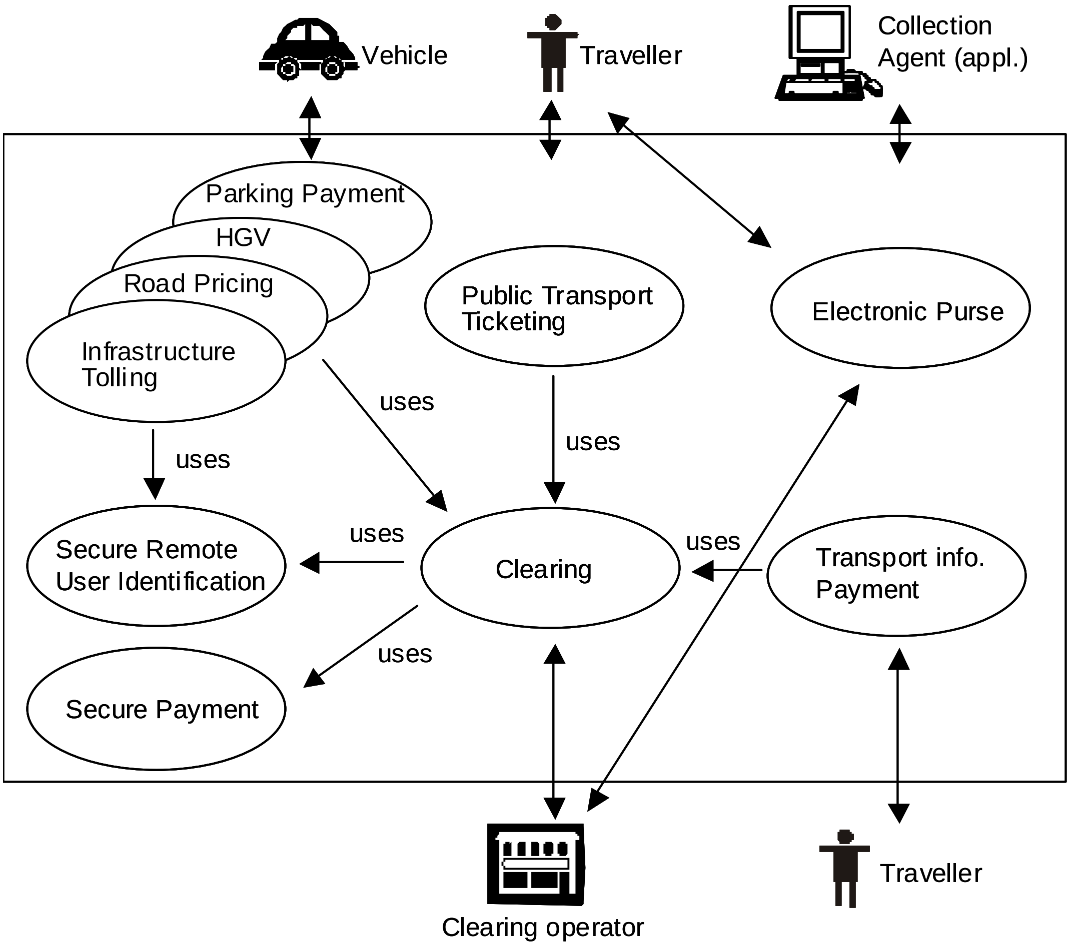
Table 5: Primary payment services and supportive payment services

Primary payment services	Road Pricing Infrastructure Tolling Public Transport ticketing Parking Payment HGV Road Usage payment Paying for Transport Information
Supportive payment services	Integrated Payment Clearing Secure Payment in communications networks Secure remote user identification Electronic Purse

The following diagram illustrates the relationship between the primary payment services and supportive payment services with an example of an architectural *use-case* diagram hereafter[18]:

[16] Financial systems are the overall system that handles financial transactions. Banks and other institutions traditionally handle these systems.
[17] A more detailed description of the payment services is given in deliverable D3.
[18] The *Use-case* methodology is defined by ISO 14813 developed by ISO TC204 Transport Information and Control Systems.

Figure 8: Comprehensive Payment Systems Use-Case



The primary payment services (e.g. Road Tolling, Public Transport Ticketing and Paying for Transport Information) are all depending on the clearing service, which is controlled by the Clearing Operator. The clearing service is based on the supportive services Secure Payment and Secure Remote User Identification, while the Electronic Purse is seen as a supportive application. Integrated payment is not included in the figure as it is a term primarily used in relation to infrastructure tolling.

A more detailed analysis of the relationship between the primary payment services and the supportive services can be seen in the table hereafter where they are mapped against each other to indicate to what extent the primary payment services are using the supportive payment services.

Table 6: Relation between primary and supportive payment services

Primary payment services / Supportive payment services	Road tolling	Road pricing	HGV tolling	Parking payment	Public transport payment	Paying for Transport information
Integrated Payment	+	+	+	++	++	+
Clearing	++	++	++	+	+	+
Secure payment in communications networks	0	+	+	+	0	+
Secure remote user identification	+	++	++	0	0	0
Electronic Purse	+	+	0	+	+	0

Legend:

++ Strong support to the primary payment service

\+ Supports the primary payment service

0 Not necessary for the primary payment service

The analysis shows clearly that from the view of Comprehensive payment systems, the clearing service is more or less a prerequisite: without access to clearing, no integrated or interoperable services will exist.

From a service point of view, the electronic purse can also be seen as a purely supportive facility: It is not indispensable, but access to the electronic purse will increase the level of service for the primary service, and smoothen its operation. Access to secure payment in communication networks is most relevant for services using post-payment routines, e.g. where higher amounts are communicated (HGV tolling and parking payment) or where the service is acquired over the network (transport information) and where no fixed contractual relationship between the user and the service provider is already established (e.g. the road tolling environment). The specific need of secure payment in the case of Road Pricing comes from the expected absence of ”traditional” payment stations. Which means that user fees primarily will be communicated in electronic form rather than entered into the system as cash.

This is also reflected in the need for secure remote user identification in the HGV tolling and road pricing services. Where the transfer of funds is made automatically via communications networks, the identity of the parties in the transaction (sender and receiver) must be certified. Secure identification can also be used to replace fund transfer, when for example service specific central accounts are used.

5.2.2 Political responsibility towards the supportive payment services

From a policy point of view, the responsibility for the provision of the primary services is quite clear: The service providers behind road tolls and public transport are well defined, and also the political responsibility is well defined at national and European level.

Looking at the supportive services the responsibility is not clear. The requirements and needs from the transport sector have to be balanced with the interest coming from other sectors. It is therefore important to determine to what extent supportive services are needed or mainly needed in the transport sector.

Integrated payment turns out to be a service mainly needed for the use of primary payment services in transport. Also the electronic purse application is needed to a higher degree in the transport sector than other sectors. Clearing, secure payment in communication network and secure user identification in communication network are all issues that are strongly needed by the primary transport payment services, but where the transport applications only constitute a minor part of the total use of these services.

The conclusion is that in particular the development of integrated payment, and to some extent also secure remote identification and the electronic purse, will be driven by the demands of the transport sector. It is also obvious that clearing and secure payment are a prerequisite for these services. Therefore, it is important that DG Transport is aware of the fact that these issues cannot be ignored, if the visions of the transport policy of the European Union are to be realised. DG Transport cannot rely on the fact that enough focus on these issues are found in other parts of the European Union, as both electronic payment and electronic purse to a large extent are driven by the demands of the transport sector and clearing is required to enable inter-operability.

Concerning secure remote payment and secure remote user identification for payment there is not the same need for DG Transport to follow the developments, as these areas are of much broader interest for other sectors in the European Union. DG Transport should be aware of the fact that there could be a number of sub-areas in each of these issues, where there is a very specific demand from the transport services. Some of these sub-areas might not be sufficiently developed by the other sectors of the European Union.

5.2.3 Policy impact analysis

The interest of the European Commission in electronic payment services will depend on the positive contribution of these services as regards the fulfilment of the objectives of the Common Transport Policy (CTP). To study the potential contribution of Comprehensive payment systems, each of the electronic payment services have been analysed. For each electronic payment service the effect on 6 main objectives of the CTP has been estimated. The details in the analysis can be found in the background report. The result of the analysis is shown in the table hereafter.

Table 7: The impact of Comprehensive payment systems related to a number of CTP areas

Application	Safety	Environment	Inter-modality	Network performance	Mobility	Equity
Road Pricing	0	++	+	+	0	-
Road tolling	+	+	0	+	0	0
Electronic ticketing	0	+	+	+	0	0
Electronic ticketing parking	0	-	+	0	0	0
Integrated payment	0	+	++	+	0	0
Clearing	0	+	++	+	0	0
Electronic ticketing HGV	0	++	+	+	0	0
Paying for transport information	0	+	++	+	+	-
Secure payment	0	0	0	+	+	0
Secure remote user identification	0	0	+	+	+	0
Electronic purse	0	0	+	0	+	0

Legend:

++ Supports strongly + Supports
0 No or unclear impact
- Counteracts -- Counteracts strongly

This table shows that there seems to be a strong positive correlation between continued and targeted introduction of electronic payment services and the objectives set by the CTP.

Generally speaking, the objectives of the transport policy (improve environment, inter-modality and equity, increase safety, network performance and mobility) seem to be supported by the introduction of Comprehensive payment systems. Although, it is also shown that some of the Comprehensive payment systems should be introduced with considerable care, as negative side effects (e.g. negative public opinion) may occur, if the services are introduced too hastily.

The benefit stemming from electronic payment services is though unevenly spread across the six policy areas described above. It is seen that the most positive impact is found on intermodality. The many aspects of the different comprehensive payment systems support increased intermodal transport, because:

- it becomes easier for the user to pay when using different transport modes,
- new inter-modal transport services emerge when efficient payment is enabled
- the cost of using roads may be raised locally, making public transport and Park & Ride alternatives more attractive

Another interesting aspect is that network performance will increase as:

- Congestion is reduced by Road Pricing
- Boarding in public transport is quicker due to electronic ticketing
- HGV transport is preferring off-peak hour driving

Also the environment will benefit from the introduction of comprehensive payment systems because:

- Road pricing will reduce traffic
- Electronic ticketing and integrated payment will increase public transport patronage

Generally, mobility will increase as payment for access to alternative and combined transport modes improves, and as harmonised payment services across national borders facilitates travelling.

With a view to equity issues, concern should be taken that introduction of pricing measures, e.g. Road Pricing, does not harm the poorest in society. A careful introduction of Road Pricing and tolling can ensure that such negative impact is reduced. However, it should be underlined that it is not the Comprehensive payment service as such that risks bringing such adverse effects. Equally, commercial distribution of traffic and travel information will give the paying clients better information, and thus help them to e.g. select better routes through congested networks. This will, on the other hand, improve the overall network efficiency, and thus improve the situation also for those without equal access to the information services.

In the area of safety no significant impact is expected of comprehensive payment systems, except for the positive safety effect achieved where e.g. manual toll lanes are replaced with automatic toll facilities.

5.2.4 Barriers to deployment

In this section the barriers[19] to the deployment of transport payment services, are described. Barriers are understood as all kinds of obstacles hindering the deployment of new services and retarding the further deployment of services already starting to penetrate the market. Due to such barriers, Electronic payment services are either not deployed at all or deployed at a too slow rate, thereby not contributing at their full potential to the objectives of the CTP.

Much more concern is relevant when introducing completely new payment services, more barriers can be expected in these cases. This can be seen as relatively many barriers have been identified relating to road pricing.

[19] The report addresses the barriers to the integration of payment in transport services (e.g. parking payment services) but not the barriers to the introduction of the transport services themselves (e.g. parking services).

In the analysis made, the barriers to deployment have been divided into 9 groups, related to:

- the transport network impact
- technical development
- legal matters
- harmonisation and standardisation
- socio-economic aspects
- industrial aspects
- user concerns
- financial aspects
- organisational aspects

Of the total number of identified barriers, almost half of them are technical related to research, development and standardisation.

The technical barriers mainly cover access to products and services that are not yet introduced as commercial products on the market due to the fact that the technology is still not mature enough, or due to the fact that the production costs are too high.

The harmonisation and standardisation barriers are related to the problems about agreeing on how the products and services should function, to allow several industrial producers to compete and thereby open up the market. Without harmonisation and standardisation the prices of products and services will remain high, and the penetration will therefore be slow with the end result of a small contribution from Comprehensive payment System to the fulfilment of the objectives of CTP.

Of the other barriers the third most important group are the legal barriers. They are mostly found in the road pricing and tolling services, which is partly due to the fact that less information has been available on legal barriers in the other areas. The large number of legal barriers shows that legal problems hinder the deployment of Comprehensive payment systems, and need to be overcome. Most of them relate to differences between national legislation that prevents implementation of compatible technologies in all parts of the European Union, or to the difficulties in prosecuting foreign violators.

Also the remaining six groups of barriers contains a large number of serious barriers which all constitutes serious problems for the Comprehensive payment systems deployment. The distribution over the six very different categories indicates the difficulty to overcome them, as the necessary measures will vary considerably depending on the barriers. A strong, targeted initiative is necessary to handle this.

In reality, some barriers are hindering deployment to a much higher degree than others. A deeper analysis has been carried out in order to identify the barriers which constitute the principal barriers to fulfilment of the CTP goals. The restructuring and regrouping lead to the following list of eight main barriers (the first one relates to supportive services, the other ones relate to primary services):

- *Technology and organisation behind the smart card*
  The smart card is a very promising technology, but penetration is hindered by

lack of co-operation between the banks possessing technology know-how (clearing and inter-operability) and transport operators with customers. Also the different requirement of banks (contact smart card giving high security) and the transport operators (contact-free smart card giving high boarding speed) lead to a need for combi-cards that are still too expensive for large scale deployment, partly because of lack of standards.

- *Standardisation of on-board units in vehicles*
  As applications like speed adaptation, navigation and payment increasingly become common in cars, the need for on-board computer capacity in vehicles is also growing. A standardised platform of these on-board units in vehicles (with the purpose of ICT payment integration) is missing. Such a standard is needed to ensure that unit prices go down and that a Pan-European solution can be reached.
- *Standardisation of on-board units in HGV*
  Driven by the coming electronic tachograph plus German and Swiss plans to introduce HGVs electronic tolling, development towards a standardised HGVs on-board unit is on going. This development gives rise to a need for a more focused contribution to progress from the European Union in this area.
- *Lack of knowledge of impact from Road Pricing*
  Road pricing is envisaged as an important solution to congestion problems in cities and on congested European motorways, but the real impact of introducing Road Pricing is not known on neither a short nor a long time span. Research and demonstration are strongly needed in this area to clarify these questions, and how this impact is depending upon the applied pricing strategy.
- *Harmonisation and standardisation in co-operation with Eastern Europe*
  There is a strong need to involve the East European countries in the establishment of standards to ensure that the standards are not moving towards proprietary or semi-proprietary solutions.
- *Limited awareness towards the use of electronic license plates*
  The electronic license plate is a useful tool for enforcement and payment. Installation of electronic license plates in all cars in the European Union would reduce the cost of many enforcement and payment installations in the future, and open up for a multitude of new Electronic payment services. The awareness towards the introduction of electronic license plates is very limited. It is foreseen that the penetration will be delayed – there is a need for strong political attention in this area.
- *Prosecution across borders*
  Prosecution of foreigners violating e.g. traffic rules and toll payment obligations is an important problem, which will grow continuously. This is due to many factors, among which is the cost of taking legal actions in a foreign country, the difference in requirements to evidence in different countries, and the different legal framework in different countries.
- *Interoperability*
  Interoperability between payment systems is strongly needed in all areas of payment in relation to transport. Barriers relate to the use of service specific

payment means (non-compatible) and the absence of agreements between service operators allowing for clearing of claims and payments.

5.3 Policy options

In its efforts to overcome barriers, the European Union has at its disposal several policy "instruments" (see *Table 3*). There are many restrictions to what, where and when the European Union can intervene, among which one of the most important is the subsidiarity principle[20]. In this section, only instruments readily and immediately available for European Union are discussed. The table below shows the instruments available to remove the barriers to deployment per payment service.

Table 8: Policy instruments per electronic payment service

Policy instrument / Payment service	Research & development	Technical harmonisation	Co-ordination	Legislation	Financial support[21]
Road Pricing	+	+		+	
Road tolling	+	+	+	+	
Electronic ticketing	+	+			
Electronic parking	+	+			
Integrated payment	+	+	+		
Clearing		+	+	+	
Electronic HGV	+	+	+	+	+
Payment for transport information		+	+	+	
Secure payment	+	+			
Secure remote user identification	+	+			
Electronic purse	+	+			

The table demonstrates the importance of research and development (R&D) and harmonisation and standardisation (H&S) as options for the European Commission when trying to surmount the barriers to deployment of Comprehensive payment systems in transport.

The need for R&D and H&S activities is found in practically all Electronic payment services considered. The need for the European Union to participate in consensus making is found in six of the Electronic payment services showing a smaller demand for consensus making.

[20] For a more general discussion of the opportunities and limitation in the involvement of the European Union, see the previous deliverable of WP3 (deliverable D9).

[21] Financial support in relation to R&D is not included here.

Regarding legal measures, it is also found to be an important activity for the European Commission in relation to some Electronic payment services, while the need for policy statements are only found in two Electronic payment services, which can be expected to be of considerable importance from a policy point of view. Quite interesting is the need for more direct financial support, which has not been found in any of the Electronic payment services analysed.

As indicated in the table above, the European Commission has many policy instruments to choose in order to secure the fulfilment of the CTP. Using these instruments individually or in combination gives the available policy options[22].

5.4 Policy requirements

Considering the options available for the European Commission in removing the barriers, most options are found in the area of research and development and harmonisation and standardisation, while less options are identified in the area of legal measures, general policy statements, financial support, and consensus making.

The identified policy options are all important to take into consideration, but they are not all of equal importance to be transformed to requirements. Focusing on the main barriers as to exploiting the benefits of new ICT based payment technology, and taking into consideration the possible options available for the European Commission, the strongest requirements for action by the European Commission are described hereafter.

Support the development of road pricing technology in order to secure enhancement and maturation

Today Road Pricing technologies only exist at a very experimental stage. Despite the focus on marginal pricing, road pricing technologies, including kilometre charging, have not reached the market yet. Experiences will be made in the next few years from the Swiss and German implementation of HGV tolling, which will bring the technology to the market. But large-scale implementation of Road Pricing in private cars calls for new methods of enforcement. There is a requirement for continuous strong focus from DG Transport in this area, if progress should be faster.

Investigate the long-term effects of road pricing and tolling, especially on localisation issues

A concern expressed by a number of cities interested in Road Pricing is the risk of creating a recession in the priced area. This is a difficult problem, where currently no good method for analysis exists. Such methods, though, need to be developed. Also the real effect of road pricing is not known yet. The Norwegian infrastructure sites have deliberately set low prices to maximise income, without disturbing the traffic. The Singapore installation is not comparable to European cities in general. A number of smaller experiments has only given a few interesting indications, but the real traffic implication of road pricing is still not known in any full scale situation. A number of area tolling experiments are planned in the next

[22] The policy options are detailed in deliverable D3.

years, but no full road pricing experiments are currently planned. There is a requirement for further investigations from DGVII in this area for the preparation of a positive introduction of road pricing and tolling.

Keep strong focus on the introduction of the electronic license plates

The electronic license plate is a useful tool for enforcement and payment. Installation of electronic license plates in all cars in the European Union would reduce the cost of many enforcement and payment installations in the future plus open up for a multitude of new Electronic payment services. The awareness towards the introduction of electronic license plates is very limited and it is foreseen that the penetration will be delayed – there is a need for strong political attention in this area.

Support common platform development in order to secure compatibility between different electronic purse solutions and interoperability between operators

Travellers outside their own region face many problems as to transport planning, navigation and payment. The payment can be facilitated by inter-operability among the operators on the short term, thus allowing them to accept payment means from other operators. On the longer term, as most operators are expected to support some kind of electronic purses, the usage of an electronic purse should be possible at practically all service providers in Europe – no matter which platform the specific purse solution may be based upon. This should be valid for both road transport and public transport. There is a need for a stronger role of DG Transport in this area.

Develop a strategy regarding the different technological implementation of HGV in Europe

Currently both Germany and Switzerland are implementing electronic HGV fees. They will most likely use different technologies that will not support inter-operability. Considering the potential impact from these implementations, such development would not be desirable at all. A clear strategy on how to ensure future inter-operability among all European countries is needed.

Support standardisation of contact-free smart cards

The contact-free smart card becomes more and more popular as a payment mean in public transport due to the fact that it allows ticketing at higher speed than other payment means, thereby increasing the boarding speed of buses, trams etc. The smart card can also be used to introduce new fare systems and for collecting detailed travel data. As the card is not standardised sufficiently, cards from one operator cannot be used at other operators. Such an inter-operable, standardised card is desired, as this would facilitate ticketing for travellers using public transport operated by different operators. Active involvement of the European Union can remedy the situation.

Promote hybrid electronic payment cards development

The contact smart card and the contact-free smart card are very useful for different purposes. The contact cards allow high security thereby fulfilling the requirements of banks, and the contact-free cards allow fast boarding thereby fulfilling the requirements of the transport operators. As the transport operators can save money by using existing cards and clearing services from banks, and as banks can get a jump-start in the usage of their cards in case of being used for transport operations, promotion of a hybrid electronic payment cards is most needed. Initiatives from the European Union can help these sectors to co-operate better.

Support standardisation and harmonisation of better and cheaper secure electronic payment services in the transport sector

Several ITS[23] services require transfer of payments from the user to the service provider with the use of communications networks. One example is when a user needs to download a new set of digital maps for the navigation unit or access traffic information. It is important that the payment services designed and developed for communication networks are also designed to cater for the specific requirements of the transport sector: Many payment transactions generally concern minor values.

There is an obvious risk that the payment services under development and the related harmonisation procedures do not take into account the specific needs of the transport sector. A parallel can be drawn to the electronic purse standardisation where a specific work item was allocated to ensure that the requirements from the transport sector were met.

Continued support to technical development in the area (e.g. security solutions) will speed up the deployment of various ITS services, since smooth payment will be enabled. Of particular importance is the development of low cost solutions suitable for transport payment applications. Here is a requirement for policy action of DG Transport.

Support deployment of secure remote user identification

Secure identification of users is an alternative to electronic purse payment: If payment at the moment of service acquisition is not possible, identification for later invoicing is an alternative. In remote (e.g. mobile) situations where physical (DSRC, Video/OCR etc.) identification is impossible, secure remote identification is needed. This is in particular necessary when there is no dedicated roadside infrastructure for the service provision.

Each service provider has to establish an own payment system in co-operation with available communication network suppliers. The absence of agreed standards on payment procedures delay deployment of valuable services.

Development of a cheap and standardised remote identification method (e.g. an electronic ID card for GSM and Internet with associated security mechanisms) would be an important asset, which DG Transport can help to establish.

[23] Intelligent Transport Systems

6. Satellite communication and navigation systems

This chapter presents the policy requirements related to the integration of satellite communication and navigation systems in the transport sector.

6.1 Definitions

In this chapter, the phrase “information systems” covers the information provided by Satellite Navigation and the data relayed by Satellite Communication systems developed by 3rd parties and used by transport operators and the general public, all of which needs to conform to basic standards of quality and interoperability. The phrase "the Project" refers to the approach leading to an "integrated GNSS" (described later in this chapter).

The background setting out the basic position and understanding adopted towards the various technologies and systems considered within this chapter are described in chapter 3 of Deliverable D4.

6.2 Needs and opportunities

6.2.1 Common Features of All Modes - Air, Sea, Road and Rail

The **needs** of Air, Sea, Road and Rail would appear to be radically different as the laws, regulations and structure of these industries are all different even within a single European country. There are however several areas of commonality which bring the modes together and strengthen the justification for pursuing the benefits to be gained from integrated technology.

Clearly all modes have a need to know where they are at any one point in time but that knowledge is much enhanced if the position can be revealed relative to other objects both fixed and moving. Such knowledge is a major safety factor for the passengers and crew of every transport mode. Furthermore, for the transport controller to know time, location and speed of the ‘vehicle’ is of value commercially and for security reasons.

That information is further enhanced by the availability of continuous voice, visual and data communication with the ‘vehicle’. The science of transport logistics is still in its infancy but is developing rapidly with the greater locational knowledge of, and control over, the remote transport unit. The efficiency gains from applying informed logistics to the transport business is well documented[24].

The needs and demands of the transport industry for information and control are continuously expanding. The difficulties with the existing systems outlined in 3.2 and 3.3 are seen as a limiting factor to the expansion of satellite exploitation by European transport, particularly in the road sector. This view reflects the basis on which the technology is provided by the United States and the Russian Federation.

[24] Satellite Communications in Road Freight Operations, International Journal Physical Distribution and Logistics Management, volume 26 No.1 1996, Anderson S, Jorna R A M, Verweij C A

Against this background there exists a clear **opportunity** to capitalise on fulfilling the needs and demands of the market identified in the following sections.

The exact size of such transport markets is uncertain but fundamentally the markets will require stimulation and encouragement to promote the critical mass threshold where they can become self-supporting. A number of cost benefit analyses have been performed to assess the size of potential transport markets and the resulting industrial benefits from GPS and GNSS (e.g. the recent Booz Allen and Hamilton CBA study for DG Transport, Frost and Sullivan in the United States, Telespazio[25]). The estimated market sizes are significant, not only in the provision of supportive services, but also the total market for the associated user equipment (10BEuros)[26]. In Japan, the market for car navigation equipment is estimated to be at least one million units per annum for the next ten years.

The Technical University of Munich have recently completed a study[27] for the German government and estimated that the potential market for satellite based transport services, equipments and applications between 2007 and 2017 is 11.8 BEuros. The road transport sector comprises 60% of the total markets and approximately 25,000 employment opportunities will be created. This study excludes any of the global macro benefits to transport e.g. improved safety and efficiency. Clearly, the mass market exists in the road sector [28] [29].

Opportunities exist through the application of satellite navigation and communication to improve safety and commercial/industrial efficiency that are common to each mode. These are described in the following sections of this chapter.

There are several **barriers** to the exploitation of satellite technology but the issue of demand is crucial to the further development of these technologies and perhaps forms the greatest barrier to successful transport integrations. Nevertheless, other barriers do exist and can be either technology specific, or of an institutional, organisational or economic nature.

When describing barriers, it is important to make a distinction between the aviation and maritime sectors on the one hand, and the inter-modal, rail and road sector on the other hand. Aviation and maritime have well-established procedures for the introduction of new technology, whereas the benefits of new satellite-based technology to the other sectors are only now becoming recognised. Therefore, potentially, the land transport sectors have much more freedom to adapt to a new situation and may not have to respond to the deliberations of international committees and organisations, giving greater opportunities to take actions to overcome the barriers obstructing the adoption of the technologies.

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[25] Presentation to GNSS2 Forum, Working Group 4 Users and Service Providers

[26] Statement by Japan GPS Council Secretary to Civil GPS Service Interface Committee September 1999 in the International Information session

[27] Paper reference IAA-99-IAA.3.2.08 presented to 50th International Astronautical Federation in the Satellite Navigation Policies and Plans session titled *"A European Global navigation Satellite System – The German Market"*, M.Wieser on behalf of A.Vollertun, Technical University of Munich.

[28] Paper reference IV-O-09 presented to GNSS 98 conference titled Most promising markets for GNSS applications by J L Lavroff, European Commission, and P. Campagne, France Development Conseil

[29] Presentation to Civil GPS Interface Committee September 98, by Karen L Jones, James F. Davis (Arthur D. Little, Inc; Arlington, VA) titled Wireless Remote Fleet Management: Marketplace Challenges

However, of concern to all sectors is the economic question, particularly related to the provision of the communication and positioning infrastructure to support all modes of transport in the future. Does each mode determine its own destiny, or does it provide a set of user requirements that can be combined into one standard covering all modes that can be met by a common infrastructure? Satellite technology is global by its very nature and therefore the intent to have one set of mission requirements for all transport modes is vital.

GNSS is an enabling technology and therefore needs the support of other technologies to realise its benefits. That this support is not always available is a barrier. This is particularly evident in the barriers for maritime and road technology with the scarcity of adequate digital charts and maps, and also perhaps lack of a mass-market demand for them. It will certainly take many years for suitable and reliable source data to be obtained for the production of electronic charts in order for users to reap the full benefits of satellite technology. A similar situation exists in the aviation sector; for example, the differences between published navigation aid positions and the actual positions in WGS-84 co-ordinates[30]. Also there is a need to develop GNSS approach information for all appropriate airports.

Turning to satellite communications, the main barriers are linked to technical, institutional, industrial and economic issues. Satellite-based systems need to compete with terrestrial-based systems in the market place and recently there has been concern at the viability of the market for newly deployed satellite constellations. If there is a doubt about the availability of a service, then demand will reduce, especially if the service is aimed at the mass domestic market rather than transport. The demand can be related to many factors, including system and service performance, the need for the technology vis a vis other systems and services, and most importantly the benefits which the technology provides to transport.

The threats to civil liberties from the misuse of data and the potential political opposition to the systems from a very vocal and concerned group of the population cannot be underestimated as a barrier.

6.2.2 Air Transport

The Air Transport **need** for navigation and communication systems is self evident and well established[31].

One of the major beneficiaries from GNSS and Satcom is undoubtedly the aviation sector particularly in respect of air traffic management. The ability to monitor aircraft on transatlantic routes and over remote areas using satellite technology is urgently needed to increase safety. Economic and environmental benefits also accrue with the ability to perform curved approaches[32] [33]. The more effective use of civil air space is another advantage. Further in aviation, the distinction between the domains of navigation and

[30] IESSG University of Nottingham for Eurocontrol to determine differences between VOR/DME co-ordinates and WGS84

[31] ICAO Volume 1 Aeronautical Telecommunications Annex 10

[32] CGSIC 29th Meeting Presentation by Jeff Ariens, Continental Airlines, Summary Report – Appendix W: “Civil GPS: an Airline Perspective”

[33] FAA’s Plan for Transition to GPS-Based Navigation and Landing Guidance, Federal Aviation Administration 1996

surveillance are becoming less clear. Gate to gate service is now requested and possibly satellite navigation can play an important role in providing such a service.

Safety is a key feature of aviation activities and the majority of the present infrastructure services are mainly provided by mandated public authorities. The need to keep the same level of safety while increasing the efficiency of air transport to cope with continuous traffic growth and already existing congestion problems, directly leads to a specific demand in terms of satellite navigation and communication services. However, to meet this demand, many barriers do exist related to technical, institutional (certification and standards), security and defence, organisational, industrial, and most importantly economic perspectives. Satellite technology is an expensive technology to deploy, and users also need to re-equip[34]. The purchase of new equipment can be onerous for small and start-up airlines. Furthermore, safety together with linked certification actions can be expensive depending on the implementation method.

The aviation approach to sole means and dependency on Satnav requires clarification along with the associated role of Inertial Navigation Systems. New and promising methods of automatic dependent surveillance have been developed in Sweden[35] and it is vital to capitalise on such developments for the benefit of Europe.

Four areas of opportunity were identified in this mode where the use of satellite navigation and communication could improve economy, efficiency and safety. These are:

- Traffic control and management in all flight phases delivers communication facilities for oceanic and remote areas, and collision avoidance.
- Surveillance which improves the efficiency of airport management, position reporting and communication synchronisation.
- Navigation enhancements which improve both safety and efficiency through service and system integrity.
- Search and Rescue enhanced safety benefits provided by emergency incident location and reporting.

The **barriers** and **policy issues** related to the use of satellite technology by the aviation sector are summarised in the following table.

[34] Statement representative Britannia Airlines to Royal Institute of Navigation "*Satnav for Civil Aviation"* meeting December 1999
[35] NEAN, NEAP, and ADS Europe projects

Table 9: Barriers and policy issues in the aviation sector

Barriers	Policy issues
The lack of security, integrity, availability, continuity and accuracy of the signals, The current certification rules or lack of rules for satellite navigation and communication, The problems of access to information, allocation of frequencies and security of signals through cryptography all need to be addressed through an appropriate organisational framework – currently not in place, The cost of infrastructure for the smaller airlines and the potential lack of profitability to users, The potential increased overhead as satellite navigation may not be permitted to be the sole means of navigation.	To ensure interoperability with existing and future systems, To develop appropriate certification and regulation procedures, To establish the basis of payment for the service and demonstrate its cost effectiveness, To ensure the development of a secure and reliable system, To ensure the full benefits of integration are dynamically promoted within the European Union.

The aviation industry presents a huge potential to build on an already sophisticated and developed industrial use of this type of space technology. However, as it is already well served by existing systems it will look very critically at what is on offer both technically and economically before committing funds in any Public Private Partnership to implement or utilise the new system.

6.2.3 Sea Transport

The **need** to develop maritime applications based on satellite navigation and communication is extensive.

Benefits of such applications to the maritime sector are perhaps not as dramatic as they are for aviation. However, in the long term they could revolutionise many present maritime working practices such as the withdrawal of present visual aids to navigation. To secure such changes to working practices any new system would:

- Need to pass rigorous examination at the institutional level,
- Require strict enforcement at the technology level,
- Require users to continue to re-equip and retrain.

The services provided as a result of any such changes must not in any way degrade present standards and levels of services, nor compromise safety, let alone endanger the environment. The present and planned use of augmentations is not only to increase safety, but also to ensure greater efficiency in the positioning of maritime aids to navigation[36].

[36] IALA Aids to Navigation Guide 1998, chapter 7

For the mariner, as with satellite navigation systems, Satcom will play an integrated role in Vessel Traffic Services (VTS)[37] and Automatic Identification Scheme (AIS) although terrestrial communications systems will suffice for shorter distances.

There are some early indications of benefits which could be obtained in the maritime sector, (and also in road sector), by the use of automatic expert systems that enable the remote control and monitoring of transport platforms. These options ought to be explored in greater depth and more funding made available for this research.

The maritime sector has well-established procedures for the introduction of new technology and these would need to be complied with for each application.

Eight areas of **opportunity** were identified in this mode:

- Traffic control and management which could benefit from Vessel Traffic Management Information System (VTMIS), VTS, AIS, pre-arrival information, safety information, remote situation displays and positive ship control [long term future].
- Resource management which could achieve improved efficiency in the areas of intermodality, container handling, communication and port telematics, information systems, EDI to aid maritime transactions and pilot boats.
- Surveillance which would be exercised over vessels carrying hazardous cargoes and selected categories of vessels for chosen geographical areas.
- Navigation which could be enhanced and provide accurate positioning for surveying and dredging, accurate and reliable bottom profiling, accurate maps and charts, tide monitoring and service and system integrity.
- User equipment which could provide improved ease of use and hence greater safety through further integration of bridge control systems.
- ICT Infrastructure which could deliver ECS transmission including digitised charts [shore to ship], radionavigation, automatic docking, EDI interchange and download artificial intelligence [long term future].
- Search and rescue which could be enhanced by providing maritime black box location.
- Port Assets which could be more quickly assessed by structural monitoring.

The **barriers** and **policy issues** related to the use of satellite technology by the maritime sector are summarised in the following table.

[37] See reference 35, Marine Guidance Note MGN 109(M+F) issued by United Kingdom Maritime Coastguard Agency dated April 1999

Table 10: Barriers and policy issues in the maritime sector

Barriers	Policy issues
The present problems with security, integrity, availability, continuity and accuracy of the signals. The problems of access to information, allocation of frequencies and security of signals through cryptography all need to be addressed through an appropriate organisational framework – currently not in place. The possibility of non-compliant vessels trading in the European maritime area. The current certification rules or lack of rules for satellite navigation and communication. The investments in alternative systems and agreed approvals for compatible user equipment. The time required for the legislative processes to introduce new technologies.	To ensure the development of a secure and reliable system. To ensure interoperability with existing and future systems.

There have been a number of research projects in the maritime area[38] into such issues as a standard port information service. These previous research papers have influenced the work carried out within TRANSINPOL when considering this transport mode. The work has been targeted at the potential to improve traffic management and co-ordination of resources on a non-European basis. There is no such organisation as a European Maritime Information Service (EMIS) which is available to all vessels trading internationally in European waters. A co-ordinated approach would be required to establish such a service which would improve traffic management and husband the use of resources.

6.2.4 Road Transport

The potential to fulfil the Road Transport **need** for information and control systems from satellite navigation and communication based technology is possibly the most exciting opportunity presented by any of the modes. The need is clearly seen in the investment by national governments in Urban Traffic Control Systems and the current drive to perfect high speed road pricing systems. Such investments are happening across Europe and are intended to cover not only cities but also remote lengths of motorways. Motorists are also demonstrating their demand for improved in-car information by subscribing to private sector route guidance systems, and by purchasing in-car GPS based location information hardware.

[38] EC DG VII, Transport Research Programme Waterborne Sector Project Summaries, Brussels, 1998

As governments strive to reduce pollution and congestion levels the willingness to impose controls on individual cars will increase. There already exists a strong intent to impose cordon charging which is a form of fiscal control and the potential for motorway tolling to spread across Europe is growing. It is but another step to impose speed control systems in the interest of safety and emission control. The civil liberties concerns that arise from constant knowledge of location and the social exclusion concerns that fiscal control measures impose, are major policy areas that need to be addressed.

In time these present concerns will be overcome and the greater benefits of in-car route guidance, journey timing advice, voice, vision and data communication will become as essential as the mobile phone is today. The mass-market for this technology is the entire automotive industry market.

Meanwhile the Road Haulage industry is leading the way in routing and tracking of vehicles for logistical and security reasons. That market unfortunately is largely populated by the small business that still finds the cost of hardware investment too high. The market needs volume sales to drive down prices but it also needs certainty of future technology standards and policy to encourage the necessary investment.

Five areas of **opportunity** were identified in this mode:

- Traffic control and management which delivers the potential for increased travel capacity and road availability, decreased journey time, information provision for travellers and prioritisation of public transport.
- Surveillance which enables the implementation of enhanced safety and improved response to accidents, regulation enforcement, road pricing, fleet management and reduced congestion.
- Navigation which delivers the possibility or enhancement of route planning and guidance, driver assistance (automated warnings for dangerous situations, severe road contours, level crossings etc.) and collision avoidance.
- ICT Infrastructure which could provide more reliable communication of traffic information, mapping information, routing information, public transport information, modal interchange advice, parking availability information, payment system and pricing advice, process floating car data, EDI interchange, tourist information and infotainment.
- Manufacture of user equipment which delivers the opportunity to create new industries both manufacturing and service and thus, new employment opportunities across Europe

These opportunities if realised address many of the aims and objectives of the CTP including Safety, Efficiency, Environmental Improvement, Socio-economic Development, and Competitiveness. Furthermore the benefits of integration and harmonisation are clear in this mode where the data generated by all network operators, transport managers and information providers across the continent needs to be communicated to an ever increasingly mobile population. Display and communication protocols must comply with basic standards to ensure that all compliant hardware can receive and display the data from any source. The emergence of the ‘Global Automotive Telematic Standard’ (GATS)[39]

[39] www.gatsforum.com

is an encouraging development and it could form the basis of further standardisation activities.

The barriers to fulfilling the needs and grasping the opportunities are greater in this mass-market transport mode where the interface with the public is greatest and where public opinion can be roused to object and ultimately vote against the imposition of policies.

Careful scripting of the safety and economic and environmental benefits to the individual is essential to overcome the civil liberty and safety concerns. However, if the technology can demonstrate a significant reduction in congestion and therefore pollution, this, together with effective and efficient enforcement of traffic laws and regulations, may lead to sufficient acceptance of the benefits to permit overruling the privacy and safety concerns.

The European wide drive to overcome congestion and pollution is being tackled by planners and policy makers through a variety of actions including such financial measures as: congestion charging, road tolling, increased parking charges and increased parking violation fines.

The hypothecation of such revenues could be used to help fund the implementation and application of satellite technologies. Nevertheless there is still a financial barrier to mass use of the current systems on offer. The percentage of the population prepared to pay for better quality transport information is still very small and the breakthrough has not yet occurred. This may not only be a pricing threshold but also an information quality and perceived need barrier.

The **barriers** and **policy issues** related to the use of satellite technology by the road sector are summarised in the following table.

Table 11: Barriers and policy issues in the road sector

Barriers	Policy issues
Public opinion may react against policies required to regulate that each vehicle carries a tracking device, to standardise the use of any personal data collected, to harmonise and integrate systems or to permit overriding the drivers control of his vehicle e.g. speed for safety reasons	To regulate the provision of infrastructure and services, To ensure that competition exists across boundaries and technologies (standards), To ensure that interoperability is provided across boundaries, technologies and modes (standards), To control the use of data, To provide quality guarantees and liabilities, To determine the funding and operating arrangements.

6.2.5 Rail Transport

The **need** for control and communication systems on the rail network across the enhanced European Union is paramount.

The rail sector offers further justification for GNSS and Satcom with the potential to contribute to the establishment of a common railway signalling and control system throughout continental Europe[40]. Such a system could improve safety, enable better resource management of railway infrastructure and assets, permit improved track monitoring, and also form a component part of cargo tracking and tracing systems.

Therefore there are potentially benefits both to the passenger and freight sectors subject to the availability of capital funding and appropriate institutional encouragement, with the opportunity to cover countries in Eastern Europe as well.

However, it should also be recognised here that world-wide, rail transport suffers from relative low rates of return, especially when social benefits are omitted from the calculation. Furthermore, the industry approach is to certify each individual application, not to provide local, regional, or global services, but to use whatever facility or service is available at the point of use.

Six areas of **opportunity** were identified in this mode:

- Traffic control and management which could deliver improved safety (e.g. collision avoidance), positive train control and passenger information.
- Resource management which could be made more efficient and deliver improved utilisation, improved competition to the road sector and reduced energy consumption.
- Surveillance which could be exercised over hazardous cargoes and freight monitoring.
- User equipment which could provide navigation and communication capabilities.
- ICT Infrastructure which could provide EDI between service centres, communication between trains and service centres.
- Infrastructure management which could be enhanced to improve track maintenance.

The **barriers** and **policy issues** related to the use of satellite technology by the rail sector are summarised in the following table.

[40] www.cordis.lu/transport/src/eurosigrep.htm for information on European Rail Traffic Management System (ERTMS)

Table 12: Barriers and policy issues in the rail sector

Barriers	Policy issues
High safety-critical character of train management systems, No direct return on investment, Harmonisation of different European railway systems.	To provide regulation of infrastructure and services, To harmonise standards, To control and certificate the use of data, To provide quality guarantees and liabilities, To determine funding and operating arrangements, To fund R & D activities to overcome rail specific disadvantages like low signal visibility, To ensure integration of terrestrial systems (e.g. Loran-C/Eurofix).

In this sector, there is a proliferation of different types of signalling systems, some of which require replacement in the near future. There is a real opportunity to reap the benefits of GNSS if used as an enabling technology to establish and introduces a harmonised European system. Such a system would require the support and encouragement of railway companies and organisations throughout Europe and require significant capitalisation for its establishment. However, the benefits would flow from interoperability of European train systems and also from significant potential safety enhancements.

6.2.6 Summary

The needs and opportunities related to the integration of satellite communication and satellite navigation systems in transport are summarised[41] hereafter.

For all modes of transport, opportunities to improve safety and resource management are evident, given the ability to provide better transport management systems through the provision of integrated information systems. The opportunities also exist to perform present essential tasks with greater efficiency and accuracy (e.g. elimination of communication black spots).

In both the aviation and maritime sectors, the introduction of satellite-based systems and services needs to be harmonised with present terrestrial-based components. In the rail and road sectors the situation is very different and new opportunities, particularly in the road sector, abound.

It is important to highlight the potential pan-European benefits in the road sector impacting on all citizens. Road accidents result in the most casualties of any mode of transport. The combination of Geographic Information Systems, satellite navigation and satellite

[41] More detailed needs and opportunities (as well as the associated barriers and policy issues) are described in chapter 4 of Deliverable D4.

communication can enable a systematic and efficient method of traffic control particularly to monitor and provide driver assistance for large vehicles.

The Comnav concept has emerged and basically means the integrated combination of communication and navigation elements on one platform. Comnav has the potential to provide services enabling the tracking of individuals, goods and vehicles in highly populated areas and even within buildings. Position determination may be directly computed from the terrestrial communication system although today it is more realistic to use a GPS chip in a receiver. It is also important to recognise the emergence of map matching techniques particularly for the road sector. The combination of satellite positioning information, communications and map matching can efficiently enable the reliable determination of individual or vehicle position to metre-standard accuracies and in combination counteract the deficiencies of each individual technology. Powerful tools limited only by the imagination are emerging but privacy issues are linked with their realisation.

From a transport perspective, the most pressing needs are for the provision of a supportive ICT infrastructure and for protection of the GNSS information against degradation by either natural or manmade causes. It is also important to ensure that all global, regional and local elements of GNSS are interoperable and adhere to common standards. If transport, particularly the road sector, requires system and services transparency, then a common European ICT infrastructure will be required. In this case, the economic questions do become very real for such infrastructure provision.

Like other candidate technologies, the benefits of satellite navigation can only be realised if the mapping and charting tools support the available accuracies and are comprehensive for all maritime areas and European land masses. There is a need to fully investigate the safe use of electronic charts and ensure that all relevant information is included in the transfer of use from present paper charts to electronic ones. This transfer needs to be adequately researched in the interests of users as well as in the interest of manufacturers and hydrographic authorities. Also in the land sector, for applications such as route guidance and fleet management, reliable digital maps need to be provided on a commercially acceptable basis.

In several studies[42], the potential, if not need, of advanced tracing and tracking systems especially for the 'broken chains' of multimodal and intermodal transport is emphasised. This could be to improve efficiency of production processes and also to provide remote surveillance of the valuable cargoes. Moreover it has a great potential to support the safety and sustainability objectives of the CTP. For that reason DG Transport started the SITS initiative in this area. Already, there are services on offer by private companies. The global characteristics of satellite technology do have a greater potential to facilitate and stimulate tracing and tracking services across several modes of transport on a world-wide scale, resulting in greater efficiency and uniformity, and also stimulating diffusion.

In summary, the need for GNSS and the provision of Satcom for data exchange applications related to fleet management, tracking and tracing, and other monitoring

[42] Mike P Clarke, Virtual Logistics Introduction and Overview of Concepts; James A Crowley, Virtual Logistics; Transport in the Market Space; International Journal of Physical Distribution and Logistics Management Volume 28 Number 7 1998

applications has been validated. The technologies need to be developed for both the private and public sectors to achieve the optimum adoption and utilisation.

Finally one area which does not pertain to a particular transport mode and which has not been highlighted is the use of the system for military applications. The financial contribution that could be obtained from this source is potentially significant but the concern would be the conditions that could accompany a contribution. The transport industries and the users would not wish to see the provision of satellite navigation and communication based on Galileo subject to the same constraints imposed on GPS and GLONASS nor to invest in products that were dependent on data and facilities that were not certificated and guaranteed. Clearly there is an opportunity but also a possible barrier with military and security involvement in the project.

6.3 Policy requirements

Addressing the requirement to examine “the integration of information communication and navigation systems” leads to the need to define “Integrated Systems”.

The concept of integration of satellite information systems for transport is the natural conclusion of the analysis of the needs, opportunities and barriers. Such integration can occur at various levels from the provision of communication and navigation within the actual Galileo satellites; integration of standards and protocols; integration of user hardware and systems across modes and boundaries; and most fundamentally integration at a European level of the institutions of each member state dealing with aspects of navigation and communication in all modes of transport. The concept of “Integrated Systems” covers all these aspects. The potential for an Integrated Global Navigation Satellite System has already been recognised by the Community in its pursuit of establishing Galileo. The availability of a reliable and readily available positioning signal from Galileo makes an integrated GNSS an achievable reality.

Extending the concept of an integrated GNSS further leads to the conclusion of the need for a European Satellite Information Service Authority (ESISA). This centralised Authority would be responsible for all aspects of delivery and application of satellite information for transport. Under its umbrella would be existing organisations currently active in the field such as the Conference of European Postal and Telecommunication Administrations (CEPT). To focus attention on delivering the needs of the individual transport modes it is also worth considering under the ESISA umbrella the establishment of, for example, such bodies as a European Navigation Agency (ENA), or a European Maritime Information Service Agency (EMISA) and an ICT Agency (ICTA). The decision is whether to set up ESISA or to let each nation state or indeed each commercial exploiter receive position data and do with it as it wishes. The protection of the end user must be considered in arriving at a decision on this issue. Users need to be assured of the quality of the products to which they are subscribing. In coming to an answer, the Commission should also consider the scale of the potential industry that could be created on the back of an integrated GNSS and Satcom development.

The policy requirements facing the delivery of an integrated satellite navigation and communication system can be collated in different ways. It may have been simpler to address the task by considering each mode, but the alternative, and probably the more helpful, way to approach the subject is to consider the policy requirements as they relate to the GNSS and Satcom technologies with their integration into Galileo.

The policy requirements are common to both GNSS and Satcom and are:

- An early decision on the final architecture of Galileo
- An early decision on the intention to adopt GNSS and Satcom as essential elements to be compatible with Galileo.
- The need to consider the creation of an overarching European Satellite Information Service Authority with powers to grant operating licences and impose legal and technical requirements and standards: also to licence/accredit the use of the European components of the system in order to deliver quality control for the end user.
- A commitment to seek harmonised standards for the technology, the fiscal, the legal, and the administrative implementation and application of the system
- A commitment to deliver interoperability with existing and future systems
- A clear policy commitment not to allow the system to be controlled by security, political or defence interests
- A clear policy commitment to permit the commercial exploitation by the private sector of the technology[43] in both the transport and other fields.

Each of the policy requirements above generates a detailed list of Policy Actions and these are now addressed on the assumption that the Commission has positively responded to the basic requirements listed above. Without a whole hearted commitment to all these issues; the Project has the risk of floundering at several key stages but in particular when the attempt is made to generate interest in the private sector to commit investment in Public Private Partnerships (PPP). It is essential to success that PPP's are nurtured across the nation states and across the different transport modes. The exploitation of the system in other parts of the world has also to be addressed, including the way in which the revenue raised from such activities is fed back to European capital investors, therefore providing resulting benefits for European users.

The justification for these Policy Requirements arises from the analysis of the Needs, Opportunities, Barriers and Policy Issues. Clearly there are many issues generated in that analysis of each transport mode; indeed there are many that overlap. Compressing them into the Policy requirements listed above is not an exact science and there may be issues that are overlooked but the fundamental requirements to overcome the barriers and fulfil the needs and opportunities presented have been identified and presented in a digestible form.

The Policy Actions listed below expand on the Policy Requirements and uses these requirements as the structure for the following detailed proposals.

[43] ARGE mercatorpark c/o AFM Vertag

Policy Requirement 1 – To make an early decision on the final architecture of Galileo

It is essential that the architecture of the Galileo platform is known as early as possible in order for the GNSS and Satcom architecture to be configured to assess the range of potential services that could be sustained by the system.

It is also essential to know that financial support will be provided for Galileo as the financial arrangements may have a effect on how the private sector and the ultimate end user views the provision of an integrated information and communication system.

Policy Action 1: *To define and freeze the Galileo architecture and services*

Policy Action 2: *To define the financial basis under which delivery of and access to Galileo will be permitted*

Policy Action 3: *To define the management and regulation of access to Galileo data*

To obtain the greatest benefit from satellite technology for transport, it is important to create a well defined environment in which users and developers feel secure as to the future This is developed further in many of the following policy actions. The system provided must also meet the requirements of all users and not just those of the space industry.

As these Actions 1, 2 & 3 are fundamental to the development and exploitation of an integrated system they are viewed as short-term matters.

Policy Requirement 2 – To make an early decision on the intention to adopt GNSS and Satcom as compatible elements of Galileo

For many technical and commercial reasons an early decision on implementation of GNSS and Satcom are essential. There are options available as to the way forward and the Community needs to consider the development of a European ICT Infrastructure Plan. It ought to consider the basis of the current Proposed Baseline European Radionavigation Plan and review the future role of terrestrial systems in relation to satellite communications. It has been proposed that the provision of GNSS and Satcom should be confirmed. On this basis, the following actions are required:

Policy Action 4: *To seek political commitment to incorporating GNSS and Satcom into Galileo.*

Policy Action 5: *To seek commitment to the implications of an integrated Navigation and Communication system*

Policy Action 6: *To secure the necessary funds to support the Project from public and private sources*

Policy Action 7: *To seek commitment to further research to specify the optimum system for communication and navigation within Galileo including the need for redundant and back-up systems*

Policy Action 8: *To sponsor a forward look to assess the future capacity requirements and potential developments of the system*

Policy Action 9: *To define and map the future role of terrestrial systems in relation to Satellite technology including their interoperability with GSM*

To obtain the greatest benefit from satellite technology for transport, it is important to create one set of mission statements to cover all transport modes. The Users must be assured that the provision of satellite navigation and communication is not dominated by the space industry and that they are fully consulted in the planning and implementation.

Policy Actions 4, 5 & 7 are viewed as short-term matters as, like Actions 1, 2 & 3, they are prerequisites to progressing to the Actions that follow. Actions 8 & 9 are medium-term objectives while Action 6 is a mixture of short and medium in that securing a commitment to a public sector contribution is short-term, while achieving a private sector commitment will require the project definition to be fleshed out which, in the short-term, may not be possible.

Policy Requirement 3 – To consider the creation of a European Satellite Information Service Authority (ESISA) with powers

As with all information systems the value and credibility of the information is only as good as the input data and the reliability of the service. It is believed that to deliver a quality product that has world wide respect and recognition, an Authority (European Satellite Information Service Authority (ESISA)) should be created with the powers to control the project in all its phases. ESISA would have the power to grant operating licences, impose legal and technical requirements and standards, be responsible for spectrum management, and accredit the applications of satellite navigation data and communication systems in order to deliver quality control for the end user. ESISA would ensure no one sector had an overriding influence on implementation and application, including security interests.

Policy Action 10: *To propose the level of control to be exercised by a ESISA Authority over the use the project*

Policy Action 11: *To determine if the Authority should perform the role of Regulator or if the Regulator should be a separate Audit Authority overseeing both the Authority and 3rd party users.*

Policy Action 12: *To determine the level of control to be exercised over 3rd Parties during the application implementation phase.*

Policy Action 13: *To consider the integration of ENA, EMISA, ICTA and CEPT within the overarching ESISA.*

Policy Action 14: *To negotiate with the military authorities to achieve acceptable conditions for all users.*

The creation of such a regulatory body with real decision-making power is complex because it implies that part of the countries' competencies are managed at a European level, thus affecting national sovereignty, but it is worth persuading the EU members of the global benefits of such a decision.

It is believed that an ESISA role is required but not to the extent that the Authority takes responsibility over all applications or that it creates a stultifying bureaucracy.

Elements of Policy Actions 10, 11, & 12 are short–term because the structure of how this Technology is to be applied needs to be thought through from the outset and an implementation and application framework established. However, the details of, for example, Action 12 will develop as the project definition becomes clearer and therefore the Actions are also medium to long-term.

Policy Requirement 4 – To harmonise technology standards, fiscal arrangements, legal requirements and administrative arrangements

This is the area in which it is most difficult to deliver the policy objectives. There will be a need to implement European Directives in national legislation in each member state and the time scales for processing such procedures must not be underestimated. However, these are future problems to be overcome.

Policy Action 15: *To promote EU Regulations to harmonise the protocols for Data exchange between in-'vehicle' equipment and satellite receivers and also between network managers, transport operators and information providers and both in-'vehicle' units and satellites. Similar protocols need to be promoted for Communication exchanges.*

Policy Action 16: *To consider the creation of a standards and certification agency within ESISA for transport telematics interests.*

Policy Action 17: *To determine the terms and conditions under which access to the data is to be provided*

Policy Action 18: *To agree the contractual arrangements under which implementation and application of The Project is to be conducted.*

Policy Action 19: *To identify the legislation that has to be enacted and/or changed to enable the service to be operated in each member state. Such legislation includes use and abuse of data, the rights of access, the liability for quality and reliability*

Policy Action 20: *To develop the organisational arrangements for consulting the extensive user base associated with each mode*

Policy Action 21: *To introduce and gain international acceptance of software and validation standards for all satellite based information services and applications*

These Policy Actions are of a different order of magnitude than many in the overall list. It is possible to further sub-divide and augment them at a later stage if required but those listed above give an indication of the scale and complexity of the task if the decision is taken to implement an integrated navigation and communication system.

The above Policy Actions are a mixture of short, medium and long-term. Actions 18, 19, 20 and 16 need to be addressed early in the development of any implementation plan. Actions 15, 17 and 21 are necessary in advance of attempting to market the benefits of integration of navigation and communication technologies to the private sector in an attempt to secure investment. They are nevertheless viewed as medium-term actions.

Policy Requirement 5 – To deliver interoperability with existing systems

The end user, i.e. the customer, is the most important consideration in this whole exercise for without their enthusiastic participation the project will be an expensive failure. The users' first requirement is for the system they have purchased to be able to interface with the data being supplied by the various providers in whatever geographic area they may be travelling. The second requirement is for affordability. The third requirement is for a degree of stability in the hardware and software market or at least an upgrade path if at all possible. Without such stability the market penetration required to deliver affordable systems will not be achieved.

Policy Action 22: *To seek agreements with the United States on future upgrade paths to ensure interoperability between GPS and Galileo*

Policy Action 23: *To establish with the Russian Federation the future of GLONASS and the potential for interoperability*

Policy Action 24: *To establish an intermodal user forum to standardise the interfaces between modes. This is necessary if the benefits of tracking cargoes and co-ordinating modal switch are to be realised*

Policy Action 25: *To establish protocols to be used by information providers to allow for interchange and backup support to the user.*

As identified in Chapter 4, this Policy Requirement is particularly important to the aviation industry but it could be a make or break issue for the participation of any of the modes. It is potentially also difficult to deliver if international positions are adopted that are protectionist.

Policy Actions 22 & 23 are again needed early for the purpose of defining the scope of the project. They are considered short-term. Actions 24 & 25 are medium to long-term matters and are issues of application rather than implementation.

Policy Requirement 6 – To enshrine in legislation the priority of the civil uses of the system and the uses to which the data can be put.

The possibility of achieving Public Private Partnership in the implementation and operation of the system depends on the reliability of the financial returns the private sector can assume. The private sector will seek to hedge the risk of loss of income and one of the fundamental concerns will be who controls the system. They will wish to see agreements enacted to protect their investment.

The private sector will also be concerned that users are not discouraged over the use of their personal information. These concerns will arise from various groups that perceive intrusion into their personal freedoms.

Policy Action 26: *To secure guarantees for the civil use of the system.*

Policy Action 27: *To address the civil liberty concerns over the use of data including the access and retention of individual records*

Policy Action 28:	*To confirm the legal frameworks currently under development for the Information Society cover the circumstances outlined in this Policy Requirement.*

There are examples of data protection charters that have been developed, for instance, in Australia to control the use and misuse of the very detailed information that the mass-market applications of the system will generate. The Commission needs to promulgate its policy on this issue early to minimise the potential bad press that the opposition will seek to create.

Policy Actions 26, 27 & 28 are short to medium-term matters as they impact on the perception of the project by the private sector and the user. These matters need to be cleared up relatively early on, though not immediately.

Policy Requirement 7 – To maximise the commercial exploitation of the system

The success of the project depends on the mass-market take up of the technology in a similar way to the mobile phone revolution. To achieve this goal the private sector must be given every encouragement to develop the potential areas of business. This may appear to conflict with the need for licensing and regulation of the industry identified in an earlier Policy Requirement but the two are not incompatible. Indeed they can be made to work in tandem for the benefit of all, providing the level of bureaucracy is contained.

Policy Action 29:	*To promote the establishment of consultative forums for each transport sector*
Policy Action 30:	*To provide a fund to sponsor approved end user applications*
Policy Action 31:	*To appoint an over-arching body (ESISA) to develop and promulgate the system both in Europe and across the world (see Policy Requirement 3)*
Policy Action 32:	*To develop the means of marketing the service in advance of a formal body being appointed.*
Policy Action 33:	*To encourage and support the creation of industrial developments including the provision of electronic maps and charts*
Policy Action 34:	*To ensure user products are available for the European components of the system*
Policy Action 35:	*To exploit the Sat Nav and Com for non transport applications.*

The opportunity for job creation that this industry will create in each member state is politically very desirable. This new industry will have a large percentage of high quality jobs both in the implementation phase and throughout the development and utilisation of applications. The appropriate administrative structure must be established to maximise the economic benefits of this technology.

Policy Actions 29, 30 & 31 are longer–term matters that again refer to the application rather than the implementation stage. Policy Actions 32, 33, 34 and 35 are short to medium-term actions to ensure the optimum European position to secure key markets.

7. Legal issues

This chapter presents the legal impacts of the integration of information, communication and navigation technologies in transport.

7.1 Scope

Given the broad scope and diversity of the legal questions raised by the integration of the technologies mentioned above in transport, the project voluntarily concentrated on subjects which raise urgent and new questions in the field of transport:

- protection of privacy, with regards to the processing of personal data,
  The possibility to collect data in a highly efficient way, through the use of new technologies, creates risks of threats to privacy.
- electronic payments,
  Electronic payments represent a possibility for the transport service providers to increase efficiency. An analysis of the legal questions could show the most adapted instruments according to the possible problems they could generate.
- competition,
  Competition is a frequently encountered key issue when it is more and more question to completely open certain markets. In this field, the application of the "essential facilities" doctrine can provide some elements to solve the competition problems encountered by new entrants in recently opened markets.
- liability,
  Liability is addressed here in the framework of the setting up of the European contribution to GNSS 2 (GALILEO).

The analysis carried out during the project has been based on a number of case studies[44].

7.2 Protection of Privacy

7.2.1 Context

Regarding the increasing phenomenon of congestion, there is a constant wish from the public authorities to create systems that will curb the demand for private transport. The privacy issues that could raise while using those systems are of particular interest.

An analysis of the European Directive[45] on the protection of individuals with regard to the processing of personal data has been developed[46] to present the scope of application, the personal data possibly collected in transport services, the rights and obligations of the different parties (i.e. the data subject and the controller) and the possible applications of

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[44] These case studies are extensively described in deliverable D5.

[45] Directive 95/46/EC of the European Parliament and the Council of 24 October 1995 on the protection of individuals with regard to the processing of personal data and on the free movement of such data.

[46] See deliverable D5, chapter 3.

those dispositions in the field of transport. A specific attention was paid to the balance of interests that can exist between the public interests and the individual right to privacy.

7.2.2 Legal questions

Concerning Privacy, the integration of information, communication and navigation technologies in transport raises three main legal questions. They are formulated hereafter.

What kinds of personal data are collected?

According to article 2a of the European Directive on the protection of individuals, "personal data" shall mean "*any **information** relating to an identified or identifiable natural person ("data subject")*". The concept of information is therefore defined in very generic way. In the case of integration of information, communication and navigation technologies in transport, it is necessary to better identify what is meant by "personal data".

> *Example: in the case of road tolling, two types of data are certainly collected: the data related to the person when he subscribes to the service (data collected a priori) and the data related to the vehicle*

Who is the controller and what are his obligations?

According to article 2(d) of the European Directive on the protection of individuals, the "controller" is "*the natural or legal person, public authority, agency or any other body which, alone or jointly with others, determines the purposes and means of the processing of personal data*".

> *Example: in road tolling, several actors can be considered as data controllers: the systems operators, the bank or financial institution that is in charge of the payment system and the plate registration office, etc.*

The interest for identifying the controller is justified by the fact that several obligations are imposed to him (e.g. obtaining the consent of the data subject for the processing of data, collecting data for specified, explicit and legitimate purposes…). Not fulfilling these obligations may lead to situations where the privacy, the autonomy or the mobility of the citizens is endangered.

> *Example: leaving a high margin of manoeuvre to the Member States in regulating the protection regime of personal data for scientific purposes could indirectly compromise the freedom to mobility.*

What are the data subject's rights?

Articles 10 and 12 of the European Directive on the protection of individuals attribute several rights to the data subject, among which the right to know the identity of the controller and of his representatives, the right to know the purpose of the data processing, etc.

However, the Directive also mentions a number of exceptions and/or restrictions to the principle that the data subject should be informed about the future processing of his personal data. There will probably be many differences between the legislation of the various Member States concerning these exceptions and restrictions to the duty to inform.

7.2.3 Policy options

Although not exhaustive, a significant number of policy options likely to bring an answer to the legal questions related to privacy raised by the integration of information, communication and navigation technologies in transport are presented hereafter:

- due attention should be given to the free consent principle in the course of development of technical devices or at the moment of imposition of technical standards.
- technical standards, as well as all the principles inscribed in the Directive that manifestly could lead to serious diversity of state legislation should be discussed at a common forum such as the Working Party.
- processing for public interests reasons should only take place after weighing the public interests against the freedom of the citizen and reaching a proportionate balance. Processing of personal data for public interest reasons should be introduced by law and preferably by an Act of Parliament after democratic deliberation.
- once a system is installed that allows the emission and processing of information, the temptation may be great to use the system for a multitude of finalities. Lines will have to be drawn between respect for substantive democratic values and efficiency.
- processing should take place with respect of all the principles inscribed in the Directive: transparency and fair processing are the leading principles.
- when third parties have access to the data processed by the service providers; some questions remain to be solved:
  - who has the right to have access to what information processed by the service providers?
  - what procedures have to be followed so that police or other State services can have access to navigation and positioning generated personal data?
- respect for the proportionality principle should be implemented at the technological level.
- analogous with the telecommunications sector it should be rendered possible that data subjects have the right to obtain non-itemised bills

In the specific case of GALILEO, the following options have been identified:

- in the Controlled Access services (commercial and safety of life services), billing systems should be introduced where the data subject can enjoy the service without being obliged to have his personal data processed (fixed price, unreloadable paycards).
- for billing purposes only relevant data should be processed, i.e. the id-number of the receiver and time and localisation information

7.3 Electronic payments

7.3.1 Context

Electronic payment systems are more and more used in transport and there is a wide diversity in the types of payment systems but also in the functions they perform. This increasing use raises a number of legal questions. During the project, several major legal questions have been identified through the analysis of two key electronic payment means: the credit card on the one hand and the reloadable instrument on the other hand[47].

7.3.2 Legal questions

As far as the use of the credit card is concerned, the major legal questions are related to the following domains:

- evidence,
  One of the most embarrassing legal question when a credit card is used to pay in a distance contract concerns the manner to bring the evidence of the transaction and of the payment. In fact, according to the system, there will be or not a reliable identification of the parties and a track of the details of the transaction. Moreover all legal system do not accept electronic data as evidence.
- countermanding of the payment order,
  The only European legal text concerning the countermanding of a payment order is the Commission Recommendation of 30 July 1997 (97/489/EC) concerning transactions by electronic payment instruments and in particular the relationship between issuers and holders. In most of the Member States, it appears that accepting a payment without signature represents a risk for the merchant.
- liability in case of loss or theft,
  The recommendation on electronic payment (article 6) provides a complete framework to organise the burden of the risk and liability of the different parties. However, this framework does not completely establish the notion of liability. For instance, it is not always clear if the theft or loss concerns only the instrument (i.e. the card) or the means which enable it to be used (e.g. serial number and expiration date of the card).
- protection of consumers in respect of distance contracts,
  A Directive of the European Parliament and of the Council of 20 May 1997 (97/7/EC) defines the protection of consumers in respect of distance contracts. However, this directive includes a number of exclusions which make that customers concluding a distance contract for transport services would not enjoy the same protection than for other types of services.

[47] The different possibilities of payment, the credit card and the reloadable instrument are described in Deliverable D5, chapter 4.

Concerning the use of the reloadable instrument, the major legal questions are related to the following domains:

- liability in case of loss or theft,
  There are not many legal texts relating to the reloadable payment instrument. The only European text that treats really of the reloadable instrument is the recommendation on electronic payment instruments. In that text, the reloadable instrument is considered as a two-function instruments : a transaction function (non-access function) and an access to the account function. The non access function i.e. the use of the instrument for payments does not enjoy the protection of the recommendation in case of loss or theft.
- protection of privacy,
  One of the most interesting characteristic of the reloadable instrument is that it allows the possibility to store different kinds of files on a same support. It is for example possible to store on the chip a payment software, monetary values and information that constitute a title for the public transports. That kind of coexistence can create privacy troubles if a sufficient wall is not created between the different files.

7.3.3 Policy options

The policy options presented hereafter could contribute to solve the legal questions raised by the introduction of electronic payment systems in transport:

- the work on electronic signature and the adequate legal modifications in the evidence framework should be encouraged. This could help to create more confidence in the relationship between service providers and client.
- the creation of a coherent legal framework to regulate the use of electronic payment instruments in distance contracts should be encouraged. In particular, this framework should:
  - clarify the required security level,
  - ensure that this security level takes into account the possibility to contest the transaction and therefore should make possible to have a trustworthy registration of the transaction details,
  - take into account the medium prescription duration in Europe when defining the imposed duration of the archiving.
- a study is probably necessary to decide whether a specific and tailored European regulation of the distance contracts in the field of transport is necessary or not (it appears that the European Directive on distance contracts is not really applicable in the field of transport).

In the specific case of the credit card and in the field of air transport, regarding the different projects aiming at digitalising the booking and the check-in in the airports, it seems important to create a clear European legal framework for the use of credit cards in distance contracts.

As far as the reloadable instrument is concerned, the three following remarks can be formulated:

- if electronic road tolling is imposed throughout Europe, the tolling systems used in the Member States must be interoperable. However, most of the national experiences are developed without regard to that purpose of interoperability. In this context, one can wonder if the reloadable instrument (even equipped to work at a distance) is the best adapted one for that purpose if there is no rapid and clear action for interoperability?
- in order to avoid problems related to privacy, it is necessary to set clear barriers between the different types of data likely to be stored on a same reloadable instrument, so that the information will be consulted only by the relevant person.
- for the moment, the European legal framework does not impose the redeemability of the electronic monetary values stored on reloadable payment instruments. Those values are not protected against loss or theft when the instrument is used in the payment function. The European Central Bank has encouraged the introduction of such obligations (for instance in its report on electronic money). Such obligations could certainly contribute to increase the trust in electronic money instruments.

7.4 Competition

7.4.1 Context

Since a lot of infrastructures are privatised and the services are liberalised, one of the most challenging questions about the application of competition law to the transport sector concerns the guarantee of a fair access to the monopolised infrastructure for the services providers. To ensure this access, the essential facilities doctrine, based mainly on article 82 of the EC Treaty, has been developed. As this theory seems, most of the time, insufficient, the Council has adopted sector-specific regulation that imposes obligations to the infrastructure operators.

7.4.2 Legal questions

The main legal questions raised in the field of Competition relate to the conditions of application of competition law and to the obligations imposed.

Application conditions

On each of the two markets involved (upstream and downstream) one condition is required to invoke the theory. On the upstream market, the installation has to be essential to gain access to the downstream market. This implies two cumulative requirements : there is no existing alternative, even less favourable, to enter on the downstream market and secondly there is no potential alternative. This impossibility could be due to technical, financial or public interest reasons and could evolve with time. The test to evaluate if the establishment of a new installation is economically feasible should not be based on the own characteristics of the party demanding access but on the ones of a fictive company having the *same markets shares* on the downstream market than the holder of the facilities. On the downstream market, the competition has to be absent or insignificant because the consumer, whose protection is the goal of anti-trust, cares only about this market.

Obligation imposed

If a firm holds an essential facility and there is no competition on the final good's market, this firm should behave as an independent operator, as if it was not active on the downstream market. It should give access to the infrastructure on reasonable conditions, i.e. cost oriented, and non-discriminatory, even with its owns operations. The access should be gained by old clients but also by new entrants. The firm has the obligation to inform and consult the current and potential clients. Only objective technical, economical or public interest reasons could justify a refusal of access.

7.4.3 Policy options

Two possible applications have been considered:

- road tolling,
- online booking of tickets (air transport)

Possible applications in the field of road transport: the road tolling

The two main tolling technologies, namely the one based on microwave technology (DSRC) and the other based on satellite positioning (GNSS) and mobile telephone (GSM) technology, might be used for other applications than electronic fee collection, like route guidance, traffic management, protection against car theft or logistic fleet management[48]. For the provision of these value-added services, the tolling system could be considered as an essential facility. It will often be the case as it will often be indispensable to use the tolling infrastructure to provide these services. The holder of the tolling system will have to behave as an independent operator i.e. he will have to give access at every entrant on reasonable end non-discriminatory conditions. It implies that he should make his technology available to new entrants wishing to develop an interoperable service.

Possible applications in the field of air transportation: online booking of tickets

Several cases have been considered:

- Computer Reservation Systems and anti-competitive behaviours
- Airlines companies sites
- Digitalisation of tickets

[48] *Communication from the Commission on Interoperable Electronic Fee Collection System in Europe*, COM(1998) 795 final, n° 34.

Computer Reservation Systems and anti-competitive behaviours

The computerised reservation systems (CRS) are computerised systems containing information about, *inter alia*, air carriers' schedules, availability, fares and related services, with or without facilities through which reservations can be made or tickets may be issued, to the extend that some or all of these services are made available to subscribers.

That domain is regulated by articles 81 and 82 of the EC Treaty. As these articles seem insufficient, the Council enacted a code of conduct[49][50] to regulate the behaviours of the CRS owners by imposing them certain obligations. Since this code is a Regulation, it is directly binding in the Community and all relevant contracts have to be brought in line with[51]. Moreover, an agreement between undertakings to set up a CRS will be exempted on the basis of a block exemption if it respects several obligations identical to the ones contained in the code[52].

Airlines companies sites

If a carrier uses the Internet to display information only about its own services, it would not be considered as a CRS because the code definition of a CRS refers to air carriers in the plural[53]. Therefore, if a site contains information on only one company, it won't be subject to the code. If a carrier uses a CRS on its Internet site and the site is clearly identified as being the one of the carrier, it will be exempted from the articles 5 and 9.5 of the code, concerning the neutrality of the principal display[54].

Digitalisation of tickets.

If a carrier offers the possibility to issue electronic tickets to one CRS, it must offer the same possibility to all other CRS, by the application of the articles 3b and 8 of the code. In this context, the Commission has just fined the German airline Lufthansa 10,000 Euro in the first decision taken under the code of conduct[55]. In 1997 Lufthansa introduced incentives linked to the issue of electronic tickets. However, since the CRS Amadeus, of which Lufthansa is the part owner, was the only CRS able to issue such ticket at that time, the incentives could only be earned by those using the services of Amadeus. Despite requests, Lufthansa has made its electronic ticketing function available to other CRSs only in end of 1998. The Commission therefore decided that Lufthansa has contravened the article 8.1 of the code.

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[49] Council Regulation 2299/89/EEC of 24 July 1989 on a code of conduct for computerised reservation systems [1989] OJ L-220/1 amended by Council Regulation 3089/93/CEE of 29 October 1993 [1993] OJ L-278/1 and by Council Regulation 323/1999/CE of 8 February 1999 [1999] OJ L-40/1.
[50] B. ADKINS, *Air Transport and EC Competition Law*, 1994, ch. 8; J. GOH, *European Air Transport Law and Competition*, 1997, ch. 11.
[51] *Explanatory Note of the Commission on the EEC code of Conduct for Computer Reservation Systems* [1990] OJ C-184/2.
[52] *Commission Regulation 3652/93* [1993] OJ L-333/37.
[53] *Idem*, n° 42.
[54] Art. 21.1.b of the code; *Proposal*, n° 43.
[55] *Lufthansa* [1999] CMLR 574.

7.5 Liability

7.5.1 Context

As indicated in the introduction, Liability is addressed here in the framework of the setting up of the European contribution to GNSS 2 (GALILEO).

The success of GALILEO shall come from its adequate answer to the users' expectations and among others, from its ability to guarantee security, availability and accuracy of the provided services. The need for a liability framework thus really exists, but probably depends on the types of services provided by GALILEO (Open Access Service, Controlled Access Service-1 and Control Access Service-2[56]).

7.5.2 Legal questions

The examination of the international and European texts that could be applied to the use of global navigation services in transport shows that there is no liability framework applicable to services directly based on satellite signals.

A first pace would be the adoption of a European Directive. The legal questions that such a Directive should address depend on the type of service (OAS, CAS-1 and CAS-2) and on the associated levels of accuracy, continuity of service and security. This difference partly comes from the fact that in some cases there is no contract between the service provider and the end user (e.g. for OAS) while in others cases a contract binds the two parties.

Concerning the damages that could occur, a difference has to be made between damages resulting from errors or failures of the basic signal and those caused by a badly provided value-added service. If in the last case it might be possible to apply the liability framework of the Proposal for a Directive concerning electronic commerce, there is no applicable text dealing with the first kind of damages.

The ordinary legislation of the Member States should be applied in the case of damage resulting from errors or failures of the basic signal, but it would probably be a bad solution in this international context. Indeed, it seems that we are clearly facing a case of applicability of article 5 (ex-article 3 B) of the Treaty establishing the European Community. A European sovereignty on GALILEO and a European liability framework should be implemented, but all the GALILEO parties should be consulted before this, in order to consider the different liability principles.

Remark: *In a recent study[57], the defence forces warned that, in times of tension, crisis or war, they would jam or disrupt the OAS and CAS-1 services that may be used by a hostile force and would not necessarily announce it. This point has also important consequences on the notion of liability.*

[56] OAS, CAS-1 and CAS-2 are described more in detail in Deliverable D6, chapter 6.2.
[57] Civil Military Interface study

7.5.3 Policy options

Some options that could be considered for the establishment of the liability framework are described hereafter:

- military concerns have to be taken into account while implementing the liability framework. Civilian service providers should probably not be liable for military degradation of the signal.
- it would be useful to define clearly the nature of the GALILEO services in order to know, *inter alia*, if they could be considered as “Information Society services”.
- it is essential to determine exactly what is meant by OAS, CAS-1 and CAS-2, i.e. the exact service that must be provided (accuracy, corrections,…) and the information that has to be given to the user (accuracy, conditions of use of the receiver…).
- the GALILEO Vehicle Company could become a central claim desk for all the damages due to the ground and space segments of GALILEO and would thereafter sue the concerned segment on the basis of a contract concluded between the Vehicle Company and those segments. Another solution could be to create a claim desk that will dispatch the claimant to the concerned segment.
- the liability framework could use the concept of defect of the Directive 85/374 concerning liability for defective products. There could be a displacement of the proof of a fault to a proof of a defect in the service that would not correspond to the “legitimate hopes” of the end user.
- the difference between normal and abnormal errors and the technical possibility to prove the existence of an abnormal error should be determined.
- technical standards should be fixed concerning the receiver and the question of the technical possibility of making the difference between a receiver’s defect and a signal’s defect should be approached.
- the question of the need of a fund should be approached knowing that funds are generally created when there is an objective liability and risks of insolvency or when there are risks of really important damages (natural catastrophes, oil spills,…).
- it should be verified that safety-of-life transport entities have a well configured safety management and alternative navigation systems in case of disrupting of GALILEO .

8. Socio-economic issues

This chapter presents the socio-economic impacts of the integration of information, communication and navigation technologies, systems and services in transport and concludes with policy requirements associated to these impacts.

8.1 Scope for policy intervention

The effectiveness and efficiency of policy measures with respect to the integration of information, communication and navigation technologies in transport depends on the multiplied effect of two factors:

- the effectiveness and efficiency of these measures in promoting integration;
- the strength of the link between integration and socio-economic performance.

From this, two basic criteria for policy relevance and policy priorities can be derived. Policy makers should focus on those areas of integration where policy measures have a significant influence on the promotion of integration, and where the socio-economic impacts of integration are large.

8.2 Framework for socio-economic impacts

8.2.1 Definition of socio-economic impacts

In order to carry out the assessment of socio-economic impacts, criteria for the assessment must first be defined. One approach is to derive these criteria from policy statements. A concise but comprehensive statement of socio-economic policy objectives can be found in Article 2 of the Treaty establishing the European Community, which is quoted below:

"The Community shall have as its task […] to promote throughout the Community a harmonious and balanced development of economic activities, sustainable and non-inflationary growth respecting the environment, a high degree of convergence of economic performance, a high level of employment and social protection, the raising of the standard of living and quality of life, and economic and social cohesion and solidarity among Member States."[58] From this statement, the following socio-economic impacts can be derived.

[58] Article 2 of the Treaty establishing the European Community (as amended by the Treaty on European Union, Maastricht, 1992).

Table 13: Types of socio-economic impacts

Type of impact	Description
Economic growth	Increasing availability of goods and services.
Social cohesion	Fair distribution of the availability of goods and services across social groups, high level of social protection.
Economic cohesion	Convergence of the economic performance across Member States and across regions within Member States.
Employment	High level of employment.
Environment	Maintaining or improving the quality of the natural environment, stabilising or reducing environmental pollution.
Security	Protection against safety and health hazards.

The above criteria are broadly in line with socio-economic policy objectives in individual Member States[59]. In fact, they can be said to reflect the high-level policy goals of any society concerned about the individual well-being of its members.

8.2.2 Impact framework

The impact of the integration of information, communication and navigation technologies in transport on socio-economic conditions is a very complex process. A large number of causal relationships are involved, many of them indirect.

The overall impact framework is shown at an abstract level in *Figure 9*. The socio-economic impact of integration is seen to operate through two chains:

1. through the transport sector;
2. through the information, communication and navigation technologies sector.

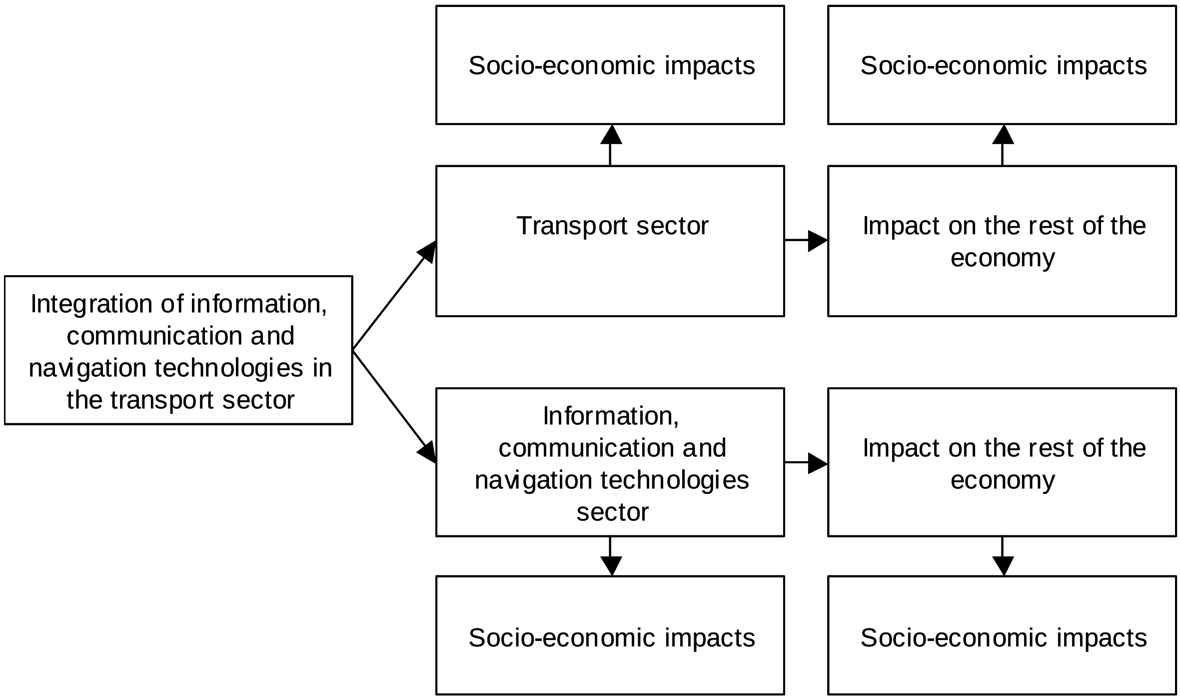
In each chain, the impacts occur in two phases:

1. direct impacts: impacts from integration on the directly affected sectors (i.e. the transport sector, and the information, communication and navigation technologies sectors);
2. indirect impacts: impacts from the directly affected sectors on the rest of the economy.

The framework is completed by relationships between the impacts of integration and the fundamental socio-economic impacts listed in *Table 13*.

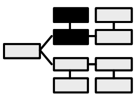
[59] See for instance the overviews of European and national transport policies in European Commission (1996) and ICCR (1997).

Figure 9: Impact framework



The different categories of impact illustrated by the figure above are described in the following sections.

Impacts of integration on the transport sector



The adoption of transport telematic systems affects in a variety of ways the behaviour of participants of the transport markets, and the performance of the transport system. The transport impact variables[60] are shown in the table below. However, they also largely correspond to the impacts listed in existing frameworks[61] for the evaluation of transport infrastructure and telematic projects.

[60] Impact variables are derived from an impact model, described in deliverable D6, Appendix 1.
[61] See deliverable D6 appendix 2 for an overview of these frameworks.

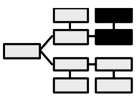
Table 14: Direct impacts on the transport sector

Type of impact	Description
Cost	Investment cost of the transport telematic system, savings in transport cost (transport infrastructure, vehicle operation, transport time, transaction cost).
Quality	Comfort, security, reliability.
Safety	Number of fatalities and injured.
Environment	Noise and air pollution, visual intrusion.
Employment	Employment in transport sector (number and skills profile)
Working conditions	Working conditions of transport workers (working time, safety)

The correspondence between the transport impacts in *Table 14* and the socio-economic impacts in *Table 13* is in most cases fairly clear. Safety, environmental effects, employment and working conditions in transport are easily seen to respectively affect the high-level socio-economic goals of security, environment, employment and social cohesion. The relations between transport cost and quality and socio-economic impacts are more complicated. A saving in transport cost can be said to increase the availability of goods and services (since it means that less resources are needed to provide transport services, so that these resources can be used to produce other goods and services). An increase in transport quality also increases the availability of goods and services (comfort is a service), or leads to cost saving (by avoiding the costs caused by transport delays or damages).

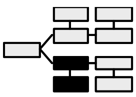
The most important socio-economic impact of lower transport costs, however, results from its effects on the economy as a whole. This impact is discussed in the next paragraph.

Impacts of the transport system on the rest of the economy



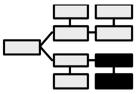
The transport sector is embedded in the overall economy. The performance of the transport system has an impact on the performance of the economy as a whole. Transport is an intermediate input used in the production of goods and services. Transport is needed not only in the production of goods (transport of the inflow of material inputs, and the outflow of finished goods) and services (commute of employees, transport of documents), but also in private consumption (transport for shopping trips, social visits and travel). It follows that the cost and availability of transport services has a profound impact on the organisation and outcomes of these economic activities. In this way, indirect socio-economic impacts are generated: output growth, employment, social cohesion and regional cohesion.

Impacts of integration on the information, communication and navigation technologies sector



The impact on the information, communication and navigation technologies sector is straightforward. The main effect of integration is the additional demand for the products and services of the information, communication and navigation technologies sector. The adoption of transport information, communication and navigation systems requires initial investments in hardware and software for the set-up of systems, and permanent purchases of information, communication and navigation services for the use of such systems. Part or whole of this additional demand addressed at the information, communication and navigation technologies sector will benefit EU companies, increasing their sales. Finally, higher sales result in higher output and employment and therefore contribute to socio-economic objectives.

Indirect impacts through the information, communication and navigation technologies sector on the rest of the economy



Only one indirect effect through the information, communication and navigation technologies sector on the rest of the economy (outside the transport sector) can be identified: the development of new non-transport information applications on the basis of developments in transport information technologies (i.e. spin-offs from transport information, communication and navigation systems), which improve productivity in the non-transport part of the economy. Since transport information, communication and navigation systems only constitute a small part of the total information, communication and navigation technologies market, technological knowledge is usually transferred in the opposite direction, i.e. from non-transport to transport applications. Hence, the indirect effect mentioned here must be considered as a fairly unlikely theoretical possibility.

8.2.3 Methodological issues in the evaluation of socio-economic impacts of the integration of information, communication and navigation technologies in transport

Most of the available information on the potential impacts of the integration of information, communication and navigation technologies in transport has been generated by pilot studies in Europe and the United States. While these studies have produced valuable data, and indeed will continue to be the main source of information for the socio-economic assessment of transport telematic services, the reliance on pilot studies raises a number of methodological problems[62]. In particular, they are related to:

- the problems involved in extrapolating the results of pilot projects to system-wide implementation;
- the emphasis on technical evaluation;
- the emphasis on road transport.

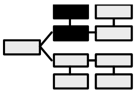
[62] These methodological problems are described in detail in chapter 2.3 of deliverable D6.

8.3 Socio-economic impacts of the integration of information, communication and navigation technologies in transport

In this section, the socio-economic impacts of the integration of information, communication and navigation technologies in transport are described[63] and analysed. The structure for the analysis is provided by the impact framework described in section 8.2.

In the next section, the direct impacts on the transport sector are covered. Section 8.3.2 discusses the indirect impacts through the transport sector on society as a whole. The impacts through the information, communication and navigation technologies sector are described in section 8.3.3. Finally, the available evidence is synthesised in section 8.4, to obtain an estimate of the EU-wide socio-economic benefits of integration.

8.3.1 Direct impacts on the transport sector



The direct impacts are presented according to the various types of impacts (marked in bold) identified in *Table 14* and according to the generic transport telematic services (market in italics) described in *Table 1*. For each type of impact, only the relevant generic transport telematic services, i.e. those that have significant impacts of the given type, are mentioned and analysed.

Cost

Market information systems increase the transparency of the transport market. They provide users of transport services (consignors or passengers) with more comprehensive information on the available services. As a result, users may be able to find a lower cost transport service provider, who would have been unknown to them in the absence of the information system, and reduce their transport bill. Market information services also increase the efficiency of the transport system, by better matching supply and demand. Suppliers of transport services are better informed about the location of cargo and passengers, allowing them to increase the load factor of vehicles.

Transaction services reduce the administrative costs associated with transport, by providing more efficient customer interfaces, improving work processes and automating administrative procedures.

Operations management services allow a better planning and use of resources during the transport operations, and thereby lower the cost of transport. For instance, load and route planning systems contribute towards increased capacity utilisation of transport equipment and vehicles. Tracking and tracing of vehicles or cargo provides the transport planner with immediate information on the location of vehicle or cargo, and on the delays incurred during transport. This permits him to implement the appropriate responses, so that further waiting times at terminals are avoided. Monitoring of vehicles (e.g. engine behaviour) or cargo (temperature of reefers) again permits fast remedial actions in case of problems, so that damages are limited.

[63] In this report, the description is limited to the qualitative aspects. Deliverable D6 also provides a quantitative description of the impacts.

Traffic information services provide drivers with information on traffic and infrastructure conditions (e.g. accidents, congestion, road repair works,...). Thanks to this information, they are able to choose alternative routes and save time.

Traffic management systems increase the capacity of the infrastructure. For instance, automatic vehicle guidance systems permit to reduce the distance between moving vehicles without endangering safety, thereby increasing the maximal throughput of the road. By means of instruction to drivers (by radio or variable message signs), the traffic flow can be guided to the parts of the network that are least congested, so that the overall capacity of the infrastructure is increased. Ramp metering systems on motorway access ramps regulate the flow of vehicles coming on the motorway so that average speed on the motorway is maintained.

A particular form of traffic management is congestion pricing, i.e. charging every vehicle a fee equal to the cost of the time delays inflicted on the other vehicles. Congestion charging regulates the capacity utilisation of the infrastructure using price as an instrument. At the optimal price, no congestion occurs or the capacity of the infrastructure is maximised. Drivers for whom the price is too high avoid paying it by choosing an other route, an other mode of transport or an other travel period. It should be noted that congestion pricing is not in itself a transport telematic application. However, transport telematic systems, notably electronic toll collection systems, facilitate the implementation of congestion pricing by substantially reducing the transaction costs. No toll booths are required, which take up space and need to be staffed. The toll can be collected without the vehicle needs to stop or slow down.

Usually, the savings yielded by the transport information, communication and navigation system outweigh the system costs, so that on balance the deployment of the system reduces generalised transport cost. Otherwise, there would be no economic incentive to implement the system. It is, however, possible that policy-makers aim at the adoption of a transport information, communication and navigation system that raises transport cost because it yields other benefits (e.g. reduction of environmental pollution).

Quality

Transaction systems increase the accuracy of the administrative procedures associated with transport (bill of lading, invoices, ...), thereby reducing rework, avoiding misroutings and generally improving the reliability of transport services.

Operations management systems increase the control over the resources used in transport operations. This results in greater reliability of the transport connections and better security of the cargo. In public transport, operations management systems can be used to better match the supply of services and market needs. A bus with flexible schedules in function of demand can offer a higher quality service in areas with low population densities. High effective frequencies can be achieved with a smaller number of buses.

Market and traffic information systems in public transport (passenger information systems) result in less stressful travel conditions. Informed passengers feel more comfortable. Information about delays reduces perceived waiting times.

Driver assistance systems[64] increase the possibilities for elderly and physically impaired persons to drive private cars.

Safety

Market information services do not directly contribute to safety. They may, however, improve safety indirectly by influencing the modal choice. The risk of accidents is higher in road transport than in the other modes. One of the reasons why non-road modes have a low share is that they are not well known to potential users. If market information services are able to address this problem and attract freight or passenger traffic to the safer non-road and collective transport modes, then they also increase safety.

Similarly, *transaction and operations management services* (except driver and vehicle monitoring systems, see below) do not directly affect safety. However, they indirectly improve the overall safety of the transport system in at least two ways: By improving capacity utilisation, they reduce the number of vehicle kilometres and the accidents associated with them. Secondly, to the extent that they reduce the cost of intermodal transport, which is burdened with relatively higher administrative and organisational costs compared to road transport, and thereby generate a shift of freight and passengers from road to safer non-road transport modes, they improve transport safety.

Traffic information and management systems have a direct positive effect on safety by informing vehicle drivers about hazardous traffic conditions (accidents, weather, bad infrastructure conditions,...), or even by automatic interventions (collision avoidance systems).

Finally, *vehicle and driver monitoring systems* (as part of operational or traffic management systems) enable a better enforcing of safety and traffic rules.

Environment

Market information systems, and *transaction systems* do not directly affect the environmental performance of transport. However, by changing the modal distribution of transport (see section on ***safety***), they may nevertheless have a profound impact on the environmental effects of transport. As in the case of safety, the environmental performance of non-road modes is generally better than that of road transport.

Operations management systems directly reduce the environmental impact of transport to the extent that they make transport more efficient (higher load factors, savings in distance travelled). As a result, the number of vehicle kilometres, and the associated environmental effects, can fall while still assuring the same effective supply of transport services (tons or passengers moved between origin and destination).

Road pricing reduces the environmental impact of transport in three ways: (i) by reducing delays caused by congestion; (ii) by promoting the use of more environmentally friendly

[64] Driver assistance systems are strictly not transport telematic systems. They mainly consist of in-car electronic devices to help drivers, such as anti-collision systems or infra-red vision, which do not make use of the integration of information, communication and navigation technologies. However, driver assistance systems may also include navigational aids, and they could be integrated with traffic information and management systems.

non-road modes of transport; and (iii) by reducing the demand for transport with higher prices.

Traffic management and information systems in road transport are directly influencing environmental impacts. They promote smoother driving patterns, thereby reducing emissions. There is also a negative effect, if these systems promote the use of faster, but longer, alternative routes.

Employment

To the extent that transport telematic services make transport more efficient by reducing travel times and increasing the load factor of vehicles (see section on ***cost***), employment in the transport sector is reduced.

Changes in the modal distribution also influence employment. In freight transport, truck haulage is more labour intensive than inland navigation or rail transport, so that a shift towards non-road modes induced by transport telematic services will reduce employment in the transport sector. This does not imply that employment in the total economy falls by as much. Rail transport, inland navigation and certainly intermodal transport employ more persons in related and supplying industries (e.g. transhipment).

In passenger transport, collective transport is evidently more labour intensive than the use of the private cars. Here, a shift towards collective transport and non-transport modes would increase employment in the transport sector.

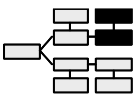
Working conditions

Transport telematic systems improve working conditions of transport workers in the first place by improving safety, and thus reducing the risk of injuries or fatalities (see section on ***safety***).

Traffic information and management services contribute to less stressful driving conditions by reducing delays and achieving smoother driving patterns.

Vehicle and driver monitoring systems (as part of operational or traffic management systems), such as digital tachographs or black boxes, allow a better enforcement of safety and social rules, and are potentially important in improving working conditions. However, they are also used and perceived as an instrument for permanent worker supervision, and then create greater stress.

8.3.2 Impacts through the transport sector on the society as a whole



The impacts through the transport sector on the society as a whole are presented according to the different types of impact (marked in bold) identified in *Table 13*.

Output and employment

Transport provides a major input into the supply chain for the production of goods and services. Lower transport costs increase the productivity of the economy in at least three ways:

- economies of specialisation;
- economies of scale;
- increased competition.

Economies of specialisation derive from comparative advantage. The exchange of goods allows each country or region to specialise in those sectors in which it is relatively more efficient than the other countries or regions. The surplus above own consumption is exported, while goods that are more efficiently produced by other regions or countries are imported. Since every country or region only produces those goods in which it is most efficient, trade improves overall productivity and makes all countries and regions better off than in the case where each would produce all goods to cover own consumption needs.

Economies of scale result from the larger size of production units and central distribution patterns that are made possible by the increased geographical scope. There are many reasons why an increase in output by a production unit is often associated with a less than proportionate increase in production cost. For instance, fixed overhead costs are distributed over more units of output, the task division can be refined allowing the use of more specialised machinery and workers, etc. If the production technology is characterised by such economies of scale, then the growth in the size of the production unit will lower the average production cost per unit of output and increase productivity.

Finally, the increase in the geographical scope of producers increases the number of producers that can profitably serve a given geographical market and hence intensifies competition. A higher degree of competition lowers prices and induces producers to pursue efficiency gains with more fervour, further lowering cost and prices.

Regional cohesion

The impact of the spatial organisation of the economy on regional convergence is ambiguous. While it is possible to predict that lower transport costs will induce firms to concentrate production in a smaller number of factories, in order to exploit economies of scale, this does not imply that the regional concentration of production will also increase. The regional concentration of production may stay the same, but with each region specialising in a smaller range of production activities in which it has location advantages compared to other regions.

Better accessibility of peripheral regions may therefore be beneficial or harmful to the regions concerned depending on particular conditions. If the region has strong location advantages (such as well-skilled low-cost labour force), then better accessibility will increase the opportunities to exploit these advantages, and the regional economy will benefit. However, if the region does not have strong location advantages, then better accessibility will only accelerate the move of economic activities to the central regions.

Social cohesion

Transport telematic systems may improve the quality and reduce the cost of public transport, thereby increasing the availability of transport services to persons without private cars (low-income, young and elderly).

The integration of information services in transport has no direct bearing on income distribution. There is an important indirect relation, however, in the sense that electronic tolling technologies facilitate the implementation of infrastructure pricing (notably road pricing), which may have significant effects on income distribution[65].

An efficient pricing scheme based on marginal social cost pricing (including external effects) theoretically maximises economic welfare. However, the gains are not equally distributed. Six groups of winners and losers of any road pricing can be identified. The winners include:

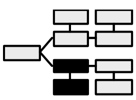
- drivers who continue to use the car and for whom the value of the time savings outweigh the level of the toll;
- users of public transport for whom the value of time savings outweigh the level of the toll

The losers are:

- the drivers or passengers who cancel trips because the value of the trip is lower than the level of the toll;
- drivers who continue to use the car, but for whom the value of the time savings outweigh the level of the toll;
- drivers who seek alternative routes without toll. By definition these routes are less desirable, or they would have been selected before electronic tolling was introduced;
- drivers who use no-toll routes and who experience higher levels of congestion due to the shift of traffic from tolled routes.

When these groups are interpreted as income classes, then the winners are seen to belong to two very different classes: on the one hand high income groups with a high value of time, and low income groups who did already use public transport and now benefit from time savings. Notice that this is at variance with the often-voiced opinion that road pricing schemes only favour the higher income classes. The losers come from low and middle class income groups who drive cars. After the introduction of road pricing they either pay a toll that exceeds the value of their timesaving, or they seek for less desirable no-toll alternatives.

8.3.3 Impacts on the information, communication and navigation technologies sector



The impacts on the information, communication and navigation technologies sector are presented according to the different types of impact (marked in bold) identified in *Table 13*.

65 De Borger, Proost and Van Dender (1997), and May, Coombe and Travers (1996)

Output and employment

The adoption of transport telematic services requires investments in hardware and software for the set-up of systems, as well as permanent purchases of information, communication and navigation services for the use of those systems. Part or whole of this additional demand addressed at the information, communication and navigation technologies sector will benefit European companies, increasing their sales, output and employment.

Two important points should be borne in mind when interpreting the effects on the information, communication and navigation technologies sector. Firstly, the creation of additional demand for the products and services of the information, communication and navigation technologies sector is by itself not sufficient for the realisation of benefits to the European economy. The degree to which European companies are able to capture those benefits depends crucially on their competitiveness relative to foreign suppliers. Otherwise, the demand effects of the integration of information, communication and navigation technologies in transport will accrue to firms outside the European Union, for instance from the US or Japan.

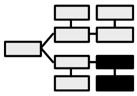
Secondly, the creation of additional output and employment does not by itself constitute a benefit to society. To large extent, value added and employment are merely transferred from the transport to the information, communication and navigation technologies sector. Indeed, the supplementary sales and revenues in the information, communication and navigation technologies sector are at the same time a supplementary expense in the transport sector. Society as a whole only gains when the new structure of production results in a more efficient supply of transport services. The effects on the transport sector are addressed in a later section.

Spin-offs

The increase in sales volume generated by the supply of transport information, communication and navigation systems and services has additional effects on the information, communication and navigation technologies sector. Firstly, the mere increase of sales and output leads to a reduction of average cost owing to economies of scale and economies of learning, thereby increasing the competitiveness of the European information, communication and navigation technologies industry. Secondly, the demand for new types of information systems and services provides a stimulus to technology and product development. Porter (1990) has pointed out the importance of home demand conditions on national or regional competitive advantage. In particular the presence of sophisticated and demanding buyers on the home market can give a region’s firms a technological and competitive lead on world markets. If the European transport sector is the most advanced user of transport telematic systems and services, then European information, communication and navigation technologies industries are likely to be the most advanced suppliers of such systems and services.

The stronger competitive and technological position of the European information, communication and navigation technologies sector finally results in an increased European Union share of the global market for transport telematic applications. In contrast with the increased sales of transport telematic systems and services to the European transport sector, the sales growth on external markets constitutes an unambiguous benefit to the European Union economy.

8.3.4 Indirect impacts through the information, communication and navigation technologies sector on the rest of the economy



Since transport information, communication and navigation systems only constitute a small part of the total information, communication and navigation technologies market, there is no significant impact on the rest of the economy (outside the transport sector).

8.4 Estimate of European Union-wide economic significance of integration

This section provides an indicative estimate of the European Union-wide economic significance of the integration of information, communication and navigation technologies in transport. The estimate is computed in the following manner.

First, some assumptions are made on the impact of integration on the transport sector. These assumptions are based on the existing information described in the preceding sections. They are expressed as percentage increase or reduction of impact variables. Subsequently, these percentage impacts on transport system variables are translated into the corresponding percentage changes in economic variables, such as value added or employment. Finally, the percentage impacts are converted to total impacts by multiplying them by the total size of the transport sector or of the economy (in 1998).

In the next section, some aggregate statistics are presented on the significance of the transport sector in the overall economy. In the section thereafter, these data will be used in the calculation of an estimate on the economic significance of the integration of information, communication and navigation technologies in transport, using the method just described.

8.4.1 Socio-economic context of transport in the European Union

The potential socio-economic significance of the integration of information, communication and navigation technologies in transport is determined by the importance of transport in society. *Table 15* presents some key indicators of transport in the European Union (EU15). Transport services account for some 5% of European Union GDP and employment. Transport (including expenses on cars, fuel and purchased transport services) is one of the largest items in household expenditure, absorbing 14% of household disposable income. Of course, these variables reflect the expenses on transport, and provide therefore only an indirect measure of its benefits. However, they clearly demonstrate that transport is a major intermediate input both in the production of goods and services (supply of inputs and distribution of outputs, commute of workers), and in the consumption of households (trips for shopping, social visits, recreation and holidays). The cost of transport also gives an indication of the potential benefits (in the form of savings in transport expenditures) from actions to make transport more efficient.

Table 15: Key indicators of EU15 transport

(1997, unless otherwise indicated)

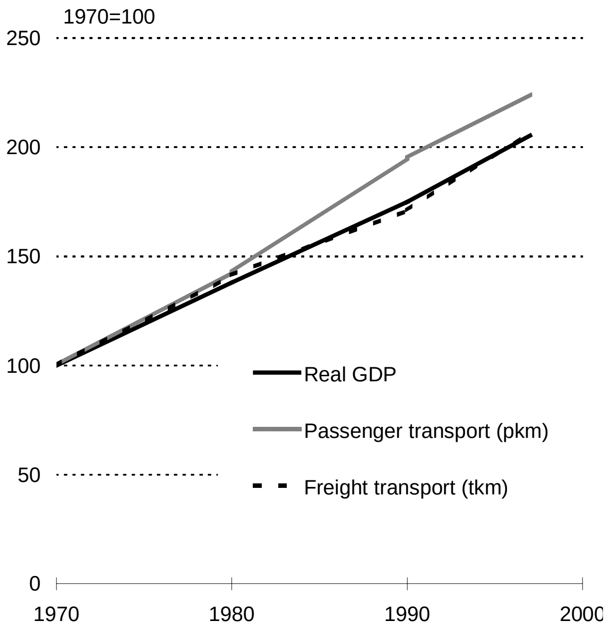
Variable	Value
Freight transport	13 billion ton 2.8 billion ton-km 20 ton-km per person per day
Passenger transport	4.8 billion passenger-km 35 km per person per day
Value added	Transport services: EUR 290 billion Transport in own account: EU 70 billion Together 5% of EU GDP
Employment	6 million persons in transport services 2 million person in transport equipment industry 6 million persons in transport-related industries and services Together 9% of persons employed in the EU
Household expenditures	EUR 600 billion 14% of disposable income
Safety	45.000 persons killed in road accidents (1995) 1.300 persons killed in railway accidents (1995) 186 persons killed in air traffic accidents (1995) 180 persons killed in accidents on sea or on inland waters (1995) EUR 167 billion socio-economic costs (1995)
Environment	26% of CO2 emissions (1995) 63% of NOx emissions (1994) 66% of CO emissions (1994) 40% of VOC emissions (1994) EUR 124 billion socio-economic cost (1991)

Source: European Commission (1999), European Traffic Safety Council (1997)

However, *Table 15* also shows that transport generates substantial social costs, as well as benefits. Every year, about 45.000 persons are killed in transport accidents, almost exclusively in road traffic. Transport is the largest or one of the largest sources of all types of air pollution. In fact, it is the only sector in the European Union where emissions of CO_2 continue to grow fast, making it impossible for the European Union to meet the CO_2 emission reductions agreed in the Kyoto protocol. Transport is the largest source of noise. Transport infrastructure occupies increasing amounts of space, and has a profound visual impact on the landscape.

Figure 10: Evolution of transport in EU15

(1970-1997)



Source: European Commission (1999)

Between 1970 and 1997, both freight transport (measured in ton-kilometres) and passenger transport (measured in passenger-kilometres) more than doubled in volume (see *Figure 10*). The figure shows that over the past decades, freight transport has closely followed real GDP growth. This evolution took place in spite of profound structural changes in this period that pointed to a lower relative demand fro transport, notably a lower energy and material intensity of industrial production and a higher share of services in the economy. However, this trend was outweighed by a increased intensity of transport use in the production process.

Passenger transport expanded even faster than GDP, mainly driven by increasing rates of individual car ownership. In 1970, there were 184 passenger cars for every 1000 inhabitants in the European Union. By 1997, car ownership had risen to 454 cars per 1000 inhabitants.

In the last three decades, the correlation between economic and transport growth has been very strong. A continuation of present trends, with another doubling of transport volumes in the next three decades, seems physically impossible given the existing space constraints and congestion levels in urban areas. Even allowing for the fact that the scope for further traffic growth has always been underestimated[66], it remains true that an extrapolation of current transport trends would require substantial investments in the expansion of transport infrastructure, with a heavy stress on environmental and land resources. The challenge for the next decades is therefore to reduce the social cost of transport, without endangering economic growth and social well-being. The following options are available:

- reduce the need for transport;
- increase the efficiency of transport;
- promote a modal shift towards non-road transport and collective transport.

The first option implies the uncoupling of transport and economic growth. It requires a transformation of production and consumption processes in order to decrease their

[66] As early as 1975, an American observer (Flink) argued that projections for a large increase in the number of motor vehicles in the US, Europe and Japan were incredible, given the already high rates of car ownership, environmental concerns, scarcity of oil reserves and land shortage. Nevertheless, the incredible occurred.

transport intensity. Then, the correlation between GDP and transport shown in *Figure 10* can be broken, and the economy can further expand without a corresponding growth in transport.

By increasing the efficiency of transport (e.g. increasing the load factors of vehicles), the same volume of effective transport services (i.e. move of goods or persons over a distance) can be supplied with a smaller number of vehicle kilometres. The required infrastructure capacity then also decreases. The correlation in *Figure 10* between ton-km, passenger-km and GDP is maintained, but the social costs of transport, which are mainly related to the number of vehicle km and the size of the infrastructure, decrease.

Finally, the third option reduces the cost of transport by promoting a shift to non-road modes of transport (e.g. rail and inland navigation) for freight transport, and to collective transport for passenger transport. The social cost of these modes (energy usage, environmental impact, safety) is much lower than for road transport.

The use of transport telematic services can contribute to the achievement of all three options. How they do this, will be described later in this report. Although it is outside the scope of TRANSINPOL, it is useful to recall at this point that non-transport information and communication technologies may also have an impact on transport demand. For example, flexible and numerically controlled manufacturing systems can reduce the minimum optimal scale of production facilities. As a result, production can be decentralised in a larger number of smaller production units, each with shorter supply and distribution channels. An other example is tele-working and tele-shopping which may have the potential to replace commuting and shopping trips, thereby reducing the need for transport while maintaining the same level of economic activity.[67]

8.4.2 Macro-economic significance of the integration of information, communication and navigation technologies in transport

Based on the available evidence given in Deliverable D6[68], the following direct impacts of the integration of information, communication and navigation technologies in transport are assumed:

- a decrease in average transport cost by 5%, owing to higher efficiency;

[67] In the case of tele-working and tele-shopping, the exact impact on transport is still unclear. On the basis of the available evidence, it seems that the impact on transport will probably be rather low. Although e-commerce is taking off fast, its ultimate penetration is not expected to reach only a few percent of consumer outlays (The Economist, 1997). The scope of electronic commerce will always be limited to those items where on-line services can provide significant value added by offering better information and a larger selection than physical stores, and where delivery costs are sufficiently low compared to value. Tele-working promises a greater potential to reduce the number of passenger trips than tele-shopping. More than half of employment is in the service sector, and much of the desk work in this sector can be performed on a remote personal computer equipped with a modem to connect to the office computer network. Pilot projects in the United States showed, however, various limits to realise this potential. Participants in the pilots only tele-commuted on average one day per week. Moreover, the attrition rates were very high, with 15% to 50% of participants quitting the programmes within a year (see for instance Balepur *et al*. (1998), Koenig *et al.* (1996), Varma *et al.* (1998), and also Transinpol Deliverable 12, p. 29 for more details).

[68] in sections 4.1, 4.2 and 4.3

- a direct increase in road safety by 10% (i.e. less 4500 fatalities), owing to the introduction of safety-enhancing systems;
- a direct reduction of transport pollution by 10%, owing to higher efficiency of vehicle use;
- an increase in non-road freight transport share by 50%, distributed equally in percentage over rail and inland navigation, leading to further improvement in safety and reduction of pollution (this means that in overland transport the modal share of rail increases from 15% of the total number of tonkm to 22%, the share of inland navigation rises from 8% to 12%, while the share of road transport falls from 77% to 66%, which would correspond to the modal distribution in 1980).

These assumptions are in line with observed impacts from existing implementations and pilot projects, with the exception of the assumed modal shift. As indicated earlier, there is no clear demonstration of a modal shift being triggered by the integration of information, communication and navigation technologies in transport. On the other hand, such effects are for various reasons much more difficult to observe than direct impacts. One important reason is that they occur with long time delays after the initial technology integration, because market participants need time to adjust their operations to make use of the new opportunities.

With the help of the elasticities given in the following table, the impact of reduction of transport cost on gross domestic product (GDP) and employment in the rest of the economy is determined.

Table 16: Macro-economic effects of changes in the transport price

NSTR	Commodity class	Labour elasticity	Value added elasticity
0	Agricultural products	-0.005	-0.005
1	Foodstuffs	-0.048	-0.066
2	Solid fuels	-0.001	-0.001
3	Oil products	-0.001	-0.001
4	Ores and scrap	-0.001	-0.001
5	Metal products	-0.034	-0.047
6	Building materials	-0.012	-0.014
7	Fertilisers	-0.007	-0.014
8	Chemicals	-0.121	-0.195
9	Other goods	-0.293	-0.252

Source: EAC (1996) based on NEI

The average elasticity is computed as a weighted sum of the elasticities for individual commodities, using the share of each commodity group in the total transport volume measured in tonkm. Both for gross domestic product and employment, the transport cost elasticity is close to –0.1, implying that a reduction of the transport cost by 1% increases gross domestic product and employment in the rest of the EU economy by 0.1%. However, a loss of output and employment in the transport sector itself by 1% must be subtracted, resulting in a net gain of 0.05% for each 1% reduction in transport cost. For a transport cost decrease of 5%, this corresponds to an increase in gross domestic product of about 17 billion EUR and employment for 400 000 persons (in 1998).

The value of the improvement in road safety has been estimated as follows. In 1995, the socio-economic cost of traffic accidents amounted to 167 billion EUR (see *Table 15*), or 2.6% of GDP at that time. 97% of this cost was attributable to road transport. A reduction of the accident cost by 10% represents therefore 0.25% of GDP. Extrapolating this figure to 1998 yields a benefit of 19 billion EUR.

A similar calculation has been carried out to compute the benefits from a reduction of transport pollution. In 1991, the socio-economic cost of pollution represented 2.2% of GDP, or 0.11% for a reduction of 5%. Extrapolation to 1998 yields a benefit of 8 billion EUR.

The value of the modal shift of freight transport has been calculated as the value of the avoided external accident and environmental costs, which are higher in road transport than in the other modes. Unit values for the external cost per tonkm are found in IFRAS/IWW (1995). The values in prices of 1991 are updated to 1998 by adding inflation over that period (using the GDP deflator for the EU). The result comes to a saving of external cost of about 11 billion EUR.

The total amounts to 55 billion EUR per year, or about 0.7% of EU GDP. The results are shown in the following table.

Table 17: Estimates of the macro-economic significance of the integration of information, communication and navigation technologies in transport

Impact on the transport sector		**Impact on EU gross domestic product (billion EUR)**	**Impact on EU employment (million people)**
Change in transport cost	-5%	17	0,4
Direct increase in road safety	+10%	19	
Direct reduction of pollution	-5%	8	
Increase non-road freight transport	+50%	11	
Total		55	0,4
Percent of EU total		0.7%	0.3%

Source: Own calculations, see text.

It should be noted that this result is an approximate estimate to obtain an indication of the value of the potential effects involved. Only a few of the impacts of the integration of information, communication and navigation technologies in transport are considered. No account is taken of the implementation cost.

8.5 Policy conclusions

As already mentioned earlier, the effectiveness and efficiency of policy measures with respect to the integration of information, communication and navigation technologies in transport depends on the multiplied effect of two factors:

- the effectiveness and efficiency of these measures in promoting integration;
- the strength of the link between integration and socio-economic performance.

From this, criteria for policy relevance and policy priorities can be derived. Policymakers should focus on those areas of integration where policy measures have a significant influence on the promotion of integration, and where the socio-economic impacts of integration are large.

In the first phase of the project[69], the scope for government intervention in the promotion of integration was considered. One of the conclusions was that government action has most value added in cases where there are large external effects, or where there are large problems of co-ordination between market participants. In such circumstances the market fails, because the benefits for individual market participants differ too much from the interests of society as a whole, so that without steering the market produces a socially undesirable outcome. Therefore, policy attention should focus on those areas where external effects and co-ordination failures are most prominent.

Overall, the socio-economic relevance of the integration of information, communication and navigation technologies in transport is clear. It was demonstrated in chapter 8.3 that integration has many current or potential impacts on transport. In turn, transport affects society in a wide variety of ways. It is a major input both in production (e.g. freight transport) and consumption (e.g. holidays) activities. Moreover, it is one of the largest sources of various forms of pollution. As a result, the potential socio-economic benefits of integration are numerous and large.

Precise knowledge of the socio-economic impacts in particular areas of integration is, however, less available. Such information is nevertheless needed to set priorities for policy intervention and compare policy alternatives, in order to maximise the socio-economic impacts of integration policy. In general, the gaps in this knowledge are due to the very complex nature of the causal relations linking the integration of information, communication and navigation technologies and socio-economic impacts, as was shown in chapter 8.3 are very complex. In particular, the uncertainties in knowledge are mainly related to the following factors:

- The network context of transport. Transport takes place in a network, in which the actions of each individual user have an impact on all the other users. As a result, it is difficult to extrapolate the results of pilot studies, which typically involve only a small number of users, to a network-wide implementation, where all or a large fraction of the transport network users are equipped. Due to negative or positive network effects, the outcome of a network-wide implementation may be much smaller or larger than the simple multiplication of the effects registered in the pilot phase.

[69] See deliverable D12 and chapter 3 of deliverable D6

- The presence of feedback effects. Direct effects may be partially nullified by indirect effects. For instance, information systems may improve the safety and efficiency of road transport. However, this will also make road transport more attractive compared to rail and waterborne transport, which are on average safer and better for the environment.
- Insufficient validation of socio-economic costs and benefits. The validation of pilot projects has focussed on operational requirements and direct user benefits, while wider socio-economic benefits have been covered much less thoroughly.

To improve the socio-economic assessment of policy measures in the field of transport information policies, the following requirements must be met:

- Promote the development of strategic transport models and of transport/land use/economic interaction models. Such models are required to take system and feedback effects into account. Suitable models are in fact already available, but they need extensive data to produce useful results. Therefore, more effort must be devoted to assure the collection of the necessary transport and socio-economic data across the European Union to render these models truly operational and useful for policy assessment.
- Promote the evaluation of socio-economic effects in the validation of pilot projects. In this way, reliable data is collected on the direct effects of the integration of information, communication and navigation technologies in transport, which can complement macro-economic and regional data to be used as an input in strategic assessment models. Guidelines for socio-economic assessment have already been developed (for instance in the CONVERGE and MAESTRO projects), but they are not always implemented in the same degree.

However, even in the absence of more precise information on the impacts of the integration of information, communication and navigation technologies in transport, some conclusions can be drawn on policy orientation. One policy priority, meeting the two criteria mentioned above, is systems promoting safety. External effects are particularly present in the case of safety. As said earlier, transport takes place in a network context. The behaviour of one individual network user affects the safety of all other users. Individual user are probably concerned about their own safety, but do not take sufficiently into account the safety of other users. Moreover, from the rough estimates computed in section 8.4, the benefits from the integration of information, communication and navigation technologies in transport in improving road safety account for a large fraction of total potential integration benefits. The areas where integration of information, communication and navigation technologies in transport has effects on safety therefore seem to be the areas where government intervention is necessary to remedy market failures, and where the socio-economic stakes are high.

9. Conclusions

The economic growth within the European Union and the future enlargement of the European Union will certainly lead to a huge increase of the transport demand (possible doubling between now and year 2010) while at the same time, more and more resistance is found in the Member States to a major expansion of the existing infrastructures because of its negative impact on the environment. In this context, it is crucial to achieve a better use and management of existing infrastructures and facilities in all transport modes (more efficient transport management, better passenger information, fair pricing, intermodality,…) while at the same time maintaining or even increasing the level of safety.

As indicated in the introduction, the integration of information, communication and navigation technologies in transport may contribute to a safer, more efficient and sustainable transport system, and to minimise the negative effects of transport growth. Political support has been, still is and will be a major factor of success for the integration. For this reason, TRANSINPOL has concentrated on providing policy makers with appropriate information to develop their policies in this field: a **framework for policy assessment** and a set of **policy requirements**.

Need for policy requirements

The integration of information, communication and navigation technologies in transport takes place through the development and deployment of new transport specific systems and services. This integration may be hindered by many kinds of barriers. In some cases, removing these barriers or at least minimising their negative effects, may require policy intervention in the framework of the CTP: this typically reflects an "operational" approach.

The deployment of new transport specific systems or services is expected to have a certain impact on the transport system and on transport operations, and to contribute through this impact to the objectives of the CTP. Ensuring an optimal contribution to the objectives of the CTP may also require policy intervention: this reflects what is called in this report the "functional" approach.

In both types of approach, the formulation of policy requirements (i.e. needs for policy intervention) is mainly driven by concerns related to the necessity to ensure that:

- changes of the transport world resulting from integration do support the objectives of the CTP,
- these changes are obtained in time,
- these changes remain sustainable as long as needed.

Scope of policy requirements

As indicated above, the integration of information, communication and navigation technologies offers opportunities to support the CTP. The current policy strategy seems oriented towards reacting to demands for integration emerging from actors in the transport sector or in the associated industry. This strategy has the advantage to build on "signals" from the market. However, the market needs do not necessarily coincide with the needs of the CTP. Therefore it might be indicated to identify, in an earlier stage, future systems and services which may become important in terms of support to the CTP. This knowledge may be used to master the policy intervention for the integration and to stimulate the demand for particular cases of integration.

Policy requirements are formulated in the scope of the CTP and therefore it is important to consider the role of the European Union in matters of integration of technology in transport. Looking at the European Union as a "director of art" and partner in co-operation, the European Union could have a more active role including responsibilities for the determination of the direction and realisation of new developments in co-operation with other actors. Such an approach is in particular valid for the transport domain and for the Information Society, because of their cross-administrative borders nature (national and public/private).

Major options in this respect are:

- to stimulate innovation through prevention of prisoner dilemma by the major actors,
- to clarify basic public responsibilities and the allocation between the various administrative levels (subsidiarity),
- to focus on the timing and the European dimension of the integration.

Identification of policy requirements

Discussions on appropriate actions to be taken by the public sector are often related to specific (technical) aspects of the integration of information, communication and navigation technologies. The fast technological development and the complexity of information, communication and navigation systems and services generally direct the discussion towards issues related to technical or organisational problems of existing systems and services. In an integrated (holistic) view, considering the fundamental objectives of the European Union, the policy options become clearer. In this holistic view, the following guidelines may be useful for the identification of policy requirements:

- to take into account the strength of the autonomous developments, like market dynamics, in particular concerning the dynamics of information, communication and navigation technologies and their applications. In many cases, they can be used as the driving force to establish integration of preferred systems and services.
- to anticipate on major technological trends, since their early signals can be observed in time.
- to combine public and private activities, in which objectives, and in particular the contribution of actions to these objectives, are clarified.

Moreover, policy requirements may become more effective if they are not limited to overcoming barriers but are placed in a more global perspective:

- the integration of information and communication technologies in the society (e.g. cellular phones, internet,…) may have impacts on the transport demand. These future changes, resulting from causes which are external to the transport world, should be known and taken into account.
- the socio-economic impacts of the integration often are not sustainable. This generally results from the absence of policy requirements dedicated to the consolidation of the impacts. Policy requirements should not only ensure that the expected impacts of the integration are obtained but also that these impacts are sustainable.
- the impacts of the integration strongly depend on the environment in which the integration takes place (e.g. already existing measures in the CTP). The formulation of policy requirements should not be limited to the integration alone but should also address its environment.

Need for a framework for policy assessment

During the project it appeared that the identification of policy requirements asked for a structured framework for policy assessment. This mainly results from the complexity of the relationships between the various aspects to take into consideration (integration-related aspects, future transport changes, CTP…). The developed framework for policy assessment is expected to support policy makers in identifying and formulating policy requirements for the integration information, communication and navigation technologies in transport.

The use of the framework for policy assessment as a model (or abstraction) of the policy making process related to integration can certainly be helpful. It provides guidance to explore the relevant components and stages in decision making. Apart from overview, insight and clarification of basic objectives, it also helps to communicate on potential policy actions and to find analogies, i.e. similar situations where solutions were already formulated and applied. In exploring success and failures of finished or on-going integration, policy requirements can be better directed towards speeding up the implementation process of innovation, required to tackle the major negative externalities of economic growth and the subsequent increase of mobility. The framework for policy assessment developed within TRANSINPOL identifies and describes:

- the main elements of the policy assessment process: the transport world, the CTP, the generic transport telematic services, technologies and the integration process
- the relations between these elements: needs, opportunities, barriers for the integration
- the various steps of the policy assessment process (from the identification of needs to the formulation of policy requirements
- areas of policy attention

A starting point to formulate transport policies

As a policy research project, TRANSINPOL has never been intended to give definitive conclusions. TRANSINPOL had to be a starting point, giving insight, overview, major issues and a route to come via the right questions to the good solutions.

In making the difference between functional and operational policy requirements, an attempt has been made to draw policy makers' attention to the opportunity they have to assure that the final impacts of the integration of information, communication and navigation technologies in transport do contribute to the objectives of the Common Transport Policy.

Moreover, although the study was oriented first of all towards policy making in transport at the European level, the major issues and the approach given are also relevant on other administrative scales, e.g. Member States, regions and urban areas, where integration of information, communication and navigation technologies in transport plays a role.

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11. Annex

The reports mentioned in paragraph 2.4 are:

- "Assessment of transport policy requirements for the system integration of information and communication services",
  TNO Inro, work package 2, deliverable D2.
- "Assessment of transport policy requirements for Comprehensive payment systems",
  PLS Consult, work package 3, deliverable D3.
- "Assessment of transport policy requirements for Satellite communication and navigation systems",
  NLB, work package 4, deliverable D4.
- "Legal impacts of the integration of new technologies in transport systems",
  Facultés Universitaires Notre Dame de la Paix, work package 5, deliverable D5.
- "Socio-economic impacts of the integration of new technologies in transport systems",
  Technum, work package 6, deliverable D6.
- "Synthesis of transport policy requirements for the integration of information, communication and navigation technology in transport",
  FDC, work package 7, deliverable D7.