Cooperative Vehicle-Infrastructure Systems

Utility analysis for the road operators

- Results from a survey

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Abstract	In order to investigate the utility, usability and acceptance of cooperative systems in transport, Rijkswaterstaat (RWS) sent out a survey to more than 200 representatives of European road operators. The survey consisted of questions on the relevance of cooperative systems for topics such as road safety, traffic management and road maintenance, questions on the usefulness and acceptance of nine examples of future applications and questions on the deployment of the systems. This document contains the results of the survey (see also the summary in this document).

Control sheet

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Abbreviations and Definitions

Abbreviation	Definition
ADAS	Advanced Driver Assistance System
CTA	Cooperative Traveller Assistance
CVIS	Cooperative Vehicle-Infrastructure Systems
DEPN	Deployment
FCD	Floating Car Data
ITS	Intelligent Transport Systems
RWS	Rijkswaterstaat
V2I	Vehicle to Infrastructure
V2V	Vehicle to Vehicle
VMS	Variable Message Signs

Summary

In the CVIS project Rijkswaterstaat (RWS) invited representatives of European road operators to react to a questionnaire. The inquirers sent the questionnaire to over 200 contacts directly. In addition at least as many persons received the questionnaire by means of distribution by ERTICO, the Highway Agency (UK), Siemens (Germany) and COOPERS. Totally 174 persons visited the website with the questionnaire, 76 started filling it out and 42 persons answered all of the questions. A large majority of the respondents works for organisations operating at the national level; about one third as managers and about one third as advisors. Over 75% have more than 6 years of experience within a road operator organisation and a similar percentage thinks they have above average familiarity with cooperative systems.

The respondents consider road safety as the most important topic for their organisations. Traffic management is at a second place. In comparison to these two topics, congestion management and road maintenance are considered as less important. Related to the topics mentioned, a large majority of the organisations already use intelligent/cooperative systems. Mostly used are signal control with dynamic optimisation, real time incident management, variable message signs, real-time information via websites, variable speed limits and lane control signals. From these systems variable message signs are the most popular for almost all purposes.

In the questionnaire the inquirers presented nine example applications of cooperative systems. The majority of the respondents consider seven of these nine applications beneficial to road traffic and six of them useful to road operators. Three of the applications are considered useful to road operators by around 70-75% of the respondents; they are the applications Obstacle warning, Area routing and control and Cooperative traveller assistance. Based on a ranking by the respondents looking at the willingness to invest, the applications can be divided in three groups roughly. The applications Road status report and Obstacle warning are considered the most important. The applications Area routing and control, Cooperative traveller assistance, In-vehicle map updates and Personalised route planning are in a middle category. The applications Flexible lane allocation, Urban parking zones and In-vehicle internet/mobile office are the least interesting or desirable to invest in. In almost all cases a majority of the respondents consider it as beneficial, that drivers dispose of information in-car. However, respondents often mention, that the information should not be in-car exclusively. More than half of the respondents think that the applications presented, cannot replace existing systems used by operators at the moment.

All respondents think that the number of cars with cooperative devices will increase. The respondents expect that in 2030 more than half of the vehicles have most of the nine applications presented. To stimulate these developments, a majority of the respondents thinks that road operators should play an important role in implementing and using cooperative applications. However, they think the roles of car manufactures, the government and service providers are even more important. Regarding the initial investments for cooperative systems, most of the respondents think the public authority has the most important role.

Almost all respondents consider cooperation among stakeholders important or even indispensable for the deployment of cooperative systems. A majority thinks, that the lack of cooperation is the biggest barrier for implementing cooperative systems (more important than the lack of funding). More than half of the respondents thinks that cooperating with the deployment of systems for road charging would also be beneficial.

Installing systems in cars as standard equipment (instead of optional) is seen as the most useful instrument to promote cooperative systems. Other important instruments are field operational tests and cooperative research. Financial instruments mentioned the most are tax reduction, market package (car plus starting insurance formula), insurance reduction and direct subsidies.

1. Introduction

1.1. Cooperative Systems

The mobility of people and goods generates high societal costs in terms of traffic congestion, pollution, noise, fatalities and injuries. New technologies may contribute to reducing these negative effects. E.g., road safety can benefit from the development of driver assistance applications that use sensor technologies to perceive the traffic situation around the vehicle and, in case of danger, warn the driver.

Intelligent cooperative systems based on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications hold the promise of great improvements both in the efficiency of the transport systems and in the safety of all road users. These systems will allow vehicles to cooperate directly with nearby vehicles, with the immediate roadside infrastructure, and with the Traffic Management Control Centre, sharing information on the latest traffic information for greater safety, efficiency and a better environment. Each equipped vehicle will be able to connect and communicate via local ad-hoc networks of vehicles and roadside equipment in the vicinity, and via an always-on network connection to access a wide range of travel support and other services.

1.2. CVIS

CVIS (Cooperative Vehicle-Infrastructure Systems) is a research project co-funded by the European Commission, developing functions to be installed on vehicles and on the road infrastructure. In short, the CVIS objectives are:

- to create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other;
- to enable a wide range of potential cooperative services;
- to define and validate an open architecture and system concept for a number of cooperative system applications;
- to address issues such as user acceptance, data privacy, interoperability, risk and liability, public policy needs, cost/benefit and business models, and roll-out plans for implementation.

1.3. Questionnaire

Within the framework of the CVIS project (DEPN subproject), a survey was sent out to more than 200 representatives of European road operators in order to investigate their opinions on the introduction of cooperative systems in transport. The survey consisted of questions on the relevance of cooperative systems for topics such as road safety, traffic management and road maintenance, questions on the usefulness and acceptance of nine examples of future applications and questions on the deployment of the systems.

The survey was part of the Deployment enablers (DEPN) work package (WP) 4 of CVIS: Utility, usability and user acceptance, task 4.3 the Utility analysis for each principal stakeholder. This task consisted of three separate surveys totally:

- task 4.3.1, Utility analysis for the driver of CVIS;
- task 4.3.2, Utility analysis for the manufacturer of CVIS;
- task 4.3.3, Utility analysis for the road operator in CVIS.

1.4. This document

This document describes the results from the survey among road operators. At first chapter 2 gives a description of the way the questionnaire was prepared, how contacts were approached and results were collected. Chapter 3 gives an overview of the contents of the questionnaire.

Chapter 4 focuses on the contacts to whom the questionnaire was sent and the persons who reacted to it. The chapters 5, 6 and 7 present the main results of the survey. Chapter 5 describes the response on the questions per topic, chapter 6 the reactions on the nine example applications and chapter 7 the answers on the questions about the deployment of cooperative systems. At the end of all chapters 4 to 7 there is a résumé with the main findings.

Annex A contains the questionnaire as it was sent to the contacts.

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2. Methodology

2.1. Compiling the questionnaire

The compilation of the questionnaire consisted of several steps.

First the available documentation on the other two surveys, carried out in task 4.3 were studied, i.e. The Users Survey (task 4.3.1, lit. 1) and the Manufacturers Consultation (task 4.3.2, lit. 2). These documents address usefulness and acceptance of cooperative systems among the end users and manufacturers. In addition a document on scenarios for road operators was studied, addressing important topics for road operators now and in the future[1].

In order to ensure consistency among the surveys questions from the users survey and the manufacturers consultation were used to draft the questionnaire for the road operator. However, as the target group is different, often questions had to be asked in a different way, new questions had to be added and non-relevant questions for road operators taken out.

The first draft questionnaire based on the documents and additional ideas of the compilers was presented and discussed during an internal workshop at Rijkswaterstaat (RWS). This led to a substantial number of comments, which were used to improve the first draft of the questionnaire. The improved version was sent for a second round of comments to the group who was in the internal workshop. In addition a number of other experts within the organisation were consulted. After processing the comments of this second round, the updated version of the questionnaire was distributed among the DEPN-partners for their review. The comments of the DEPN-partners and a check by a native speaker on behalf of the Department of Transport (UK) led to the version of the questionnaire, which was the base for publishing on the internet.

2.2. Use of internet tool

During the preparation of the questionnaire the way of distribution was discussed also. It should be as easy as possible for contacts to respond to the questionnaire. This was the main reason for the inquirers to use an internet tool for the distribution of the questionnaire. Contacts received an e-mail with a link in it. By clicking the link the questionnaire appeared on the screen automatically.

There are two ways of approaching contacts by means of such an internet tool. It is possible to send an invitation to fill out the questionnaire to a fixed list of contacts. In this case only the people on the list can respond to questionnaire. In this way it is possible to see what persons on the list reacted already, which can be useful to send reminders to the others. The other possibility is to send mails with links, which can be forwarded and used by everyone. This has the advantage that contacts can forward the mail within their organisation to the most appropriate person.

A number of organisations assisted RWS to distribute the questionnaire. Due to legal reasons

[1] Damaris Omasits and Peter Saleh , CVIS DEPN Topic 4: Scenario for the Road Operator, FEHRL (Arsenal Research), 16th June 2008 (lit. 3)

some of these organisations were not allowed to send lists of mail addresses to RWS. Therefore in this case contacts were approached by a general mail with a link, which could be forwarded.

The inquirers published the questionnaire on the internet almost completely like it was prepared. Only some minor adjustments were necessary, due to the underlying application. Some volunteers tested the online questionnaire. This also resulted in some very small last adjustments.

During the survey the inquirers had good experiences with the internet tool. It was easy to collect the results from the tool. This enabled the inquirers to look at the interim results several times. Only one contact reported that he was not able to open the questionnaire on his private computer due to his security settings. On request he received a Word-document with the questionnaire and returned a filled out paper version. Another contact requested a Word-document with the questionnaire, so that he could get permission from his superiors to fill it out. After he received the document and the permission, he filled out the questionnaire by means of the internet tool.

In order that respondents felt totally free about answering the questionnaire, the questionnaire was anonymous. Nevertheless respondents could leave their contact details, so that the inquirers could send them the report on the questionnaire and – if necessary – ask for clarification on the answers given. The inquirers did not publish contact details from respondents or input given by them at an individual level.

2.3. Contacts

The inquirers used names and addresses from contacts of European road operators, by using several sources:

- RWS;
  Several employees provided lists of contacts using their own national and international networks. In addition lists of members of coordination groups were used and personal contacts of the authors.
- the DEPN partners in the CVIS-project;
  On request DEPN-partners sent a number of contacts.
- CEDR (Conference Européenne des Directeurs der Routes)
  The RWS-representative in CEDR provided contact information from the other members of this organisation.
- ERTICO and
- The European project COOPERS.

ERTICO, Highway Agency (UK), Siemens (Germany) and COOPERS distributed the questionnaire internally. ERTICO sent the questionnaire to the ITS Nationals group, where each ITS National has more than 30 companies as members, and the Public Authorities Group consisting of more than 100 members. As mentioned before, some organisations were not allowed to send contact details to RWS, due to legal reasons.

The collection of names and addresses resulted in a list of over 200 persons, which were

contacted directly and probably at least as many representatives from road operators, which were contacted in an indirect way.

2.4. Collecting the data

The questionnaire was online from December 19th 2008 until February 28th 2009. On December 19th the contacts received a mail with the kind request to fill out the questionnaire. As the Christmas period started at the end of December, a reminder was sent in January.

In a number of cases mail addresses appeared to be wrong or contacts answered that they were not the right person to react. In those cases efforts have been done to correct the mail address or find contacts who are more appropriate. Besides this, in the period that the questionnaire was online also a number of new contacts were found and sent a request to fill out the questionnaire.

When the questionnaire was online for one month, the inquirers collected the interim results. The mail that was sent on December 19th mentioned a deadline of January 15. Originally the idea was to keep the questionnaire online to the end of January. As the number of people looking at the questionnaire still was growing at that time, it was decided to extend the period to the end of February. At the end of February the questionnaire was taken off line and the results were collected, analysed and reported.

3. Questionnaire

The questionnaire consists of four parts:

1. a part with questions per topic that are considered as relevant to road operators;
2. a part on a number of example CVIS applications;
3. a part with questions on the deployment of cooperative systems and
4. a part with questions on the characteristics of the persons responding to the questionnaire.

This chapter gives a brief description of the questions in the four parts. For the total questionnaire can be referred to the annex.

3.1. Topics

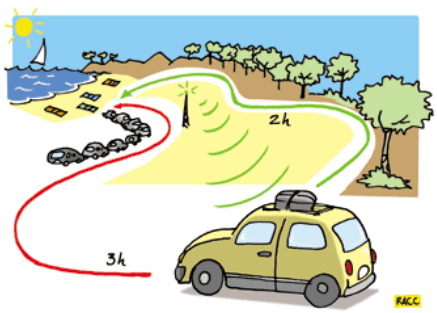
Using the document from Damaris Omasits and Peter Saleh (lit.3) on scenarios for the road operators as a base, the following topics were distinguished. These topics are considered to be relevant for the present and future tasks of the road operator:

1. traffic management;
2. congestion management;
3. road safety;
4. road maintenance.

The inquirers asked the road operators to rank the importance of these topics to their organisations and if (and how) intelligent or cooperative systems are used and will be used for these topics.

3.2. CVIS applications

Part 2 of the questionnaire addresses a number of example CVIS applications. The questionnaire gives a description of the example application and for each application a number of questions on the benefit to road traffic, usefulness to road operators, etc.



3-1 ***Application: Cooperative Traveler Assistance*** **(CTA)**

3.3. Deployment

Part 3 of the questionnaire focuses on the deployment of the applications. Investigated was the role road operators think they or others groups should play in the implementing process. In addition, there are questions regarding financing and promoting future developments.

3.4. Characteristics of the respondents

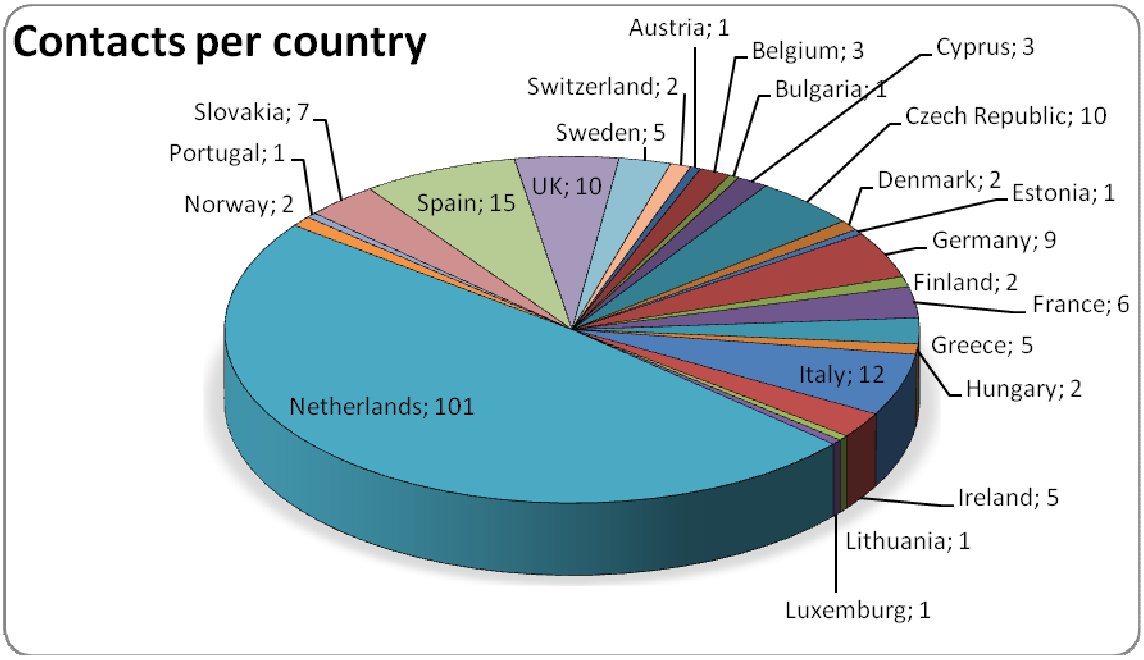
Part 4 of the questionnaire focuses on the characteristics of the contacts of the road operators who responded to the questionnaire and the organisations they are working for. There are questions on the type of organisation, the geographical scope, the role of the respondent in the organisation, the number of years of experience, etc.

In addition, the respondent from the road operator was voluntary asked to leave his/her contact details.

4. Respondents

4.1. Response to the questionnaire

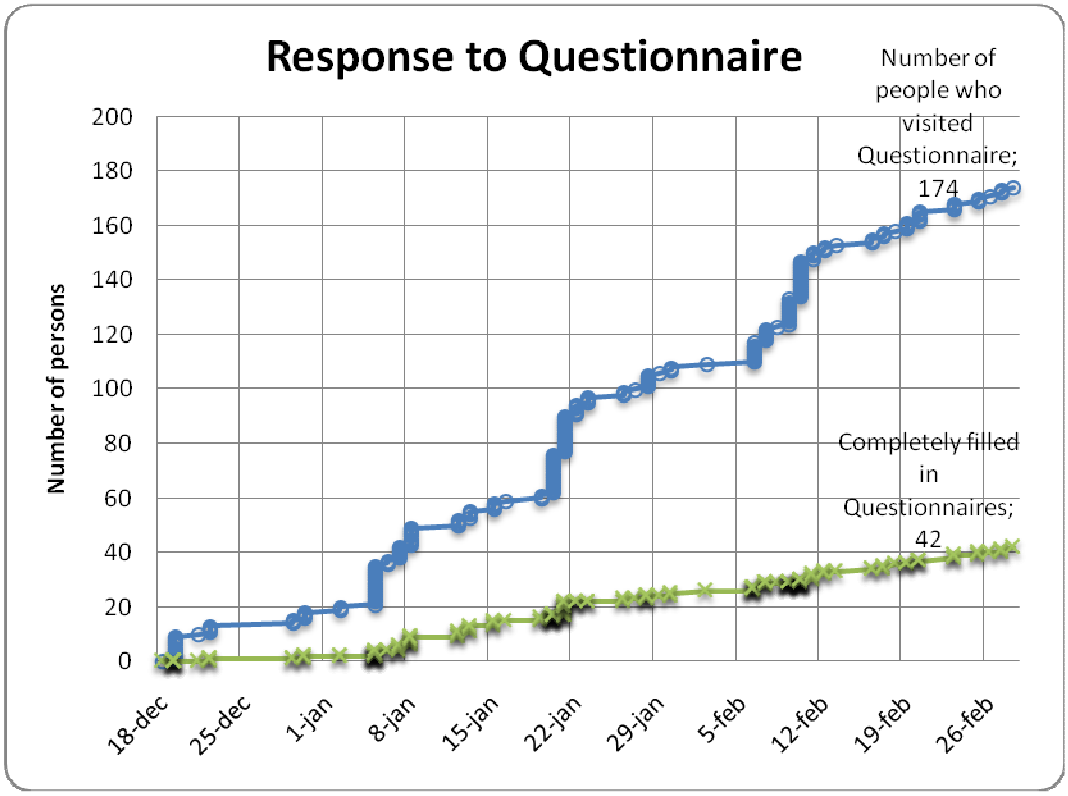
Over 200 contacts received an e-mail with a link to the questionnaire directly. These contacts are from 24 European countries, as shown in the figure below (figure 4-1). As the survey was organised by a Dutch organisation, a big part of the contacts, which was approached directly, is from The Netherlands. In addition, probably at least as many contacts (from the whole of Europe) received an invitation to take part in the survey indirectly (see chapter 2). The persons approached indirectly are not in the figure below.



4-1 Contacts per country

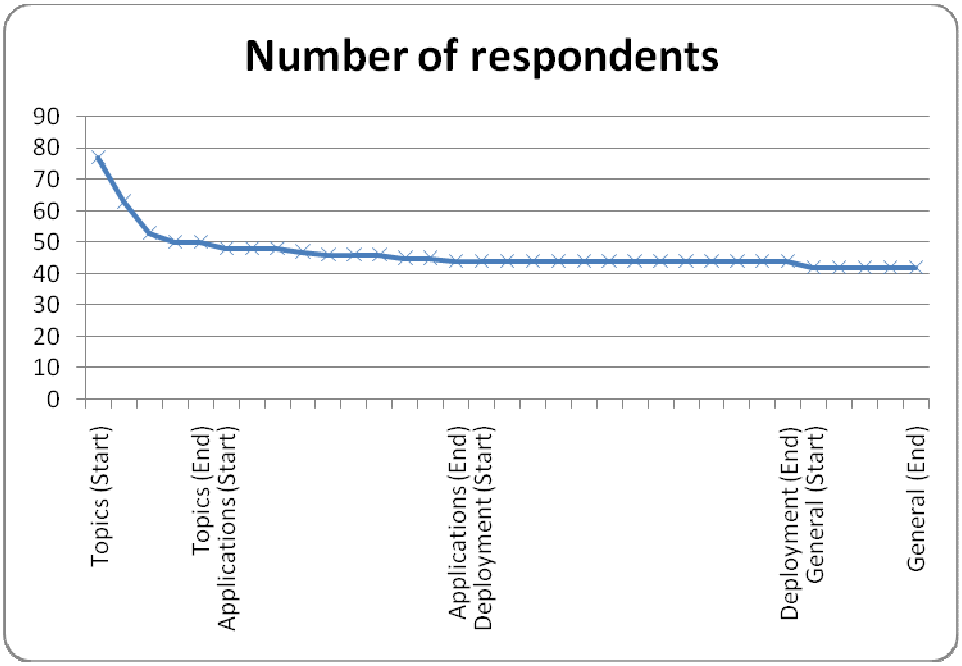
Totally 174 visited the website of which 76 started filling out the questionnaire. In the end, 42 persons completely filled out the questionnaire.

The first invitation to visit the website was sent on December 19th, 2008, a reminder was sent January 20th, 2009. The figure below (figure *4-2*) shows the number of visits of the website and completed questionnaires during the time the website was on line. In the figure one can see that a number of contacts directly looked at the website when receiving the invitation mail. During the period around Christmas very few contacts looked at the questionnaire. In the first two weeks of January one sees a substantial increase of this number. In that period the number of contacts filling out the questionnaire also increases clearly. The reminder on January 20th causes a new clear increase of number of persons looking at the website. Around that date there is also a rise of the number of persons filling out the questionnaire again.



***4-2* Response to the questionnaire**

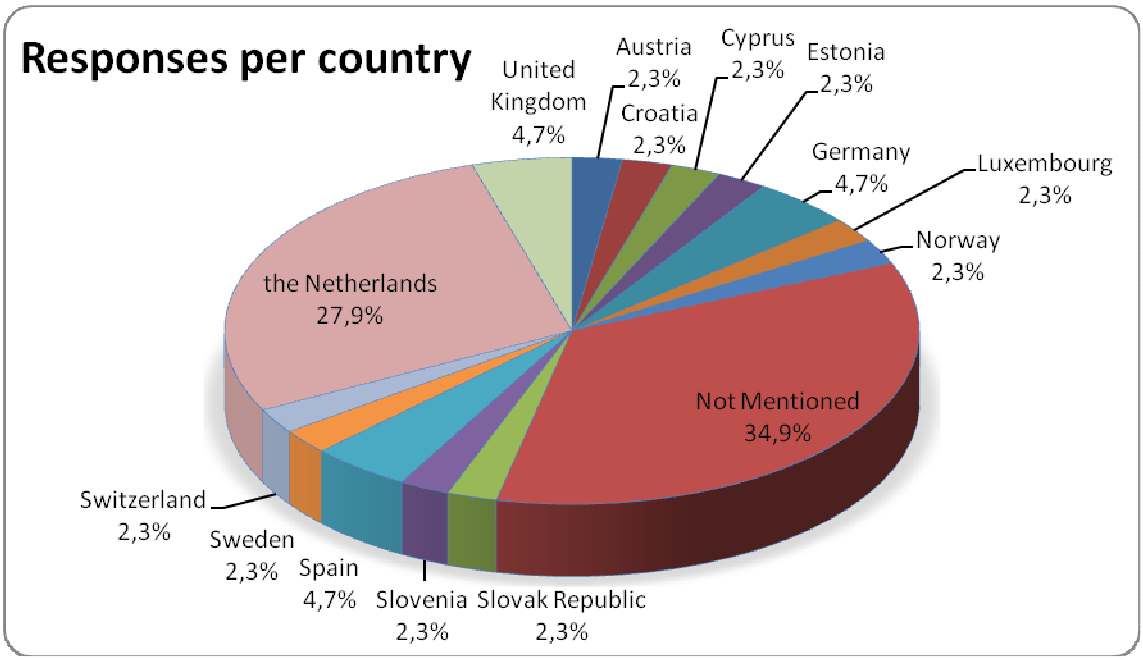
Also the number of number of responses per question in the questionnaire was analysed (see figure *4-3*). This shows that 76 respondents started filling out the questionnaire. During the first five questions ('Topics') 26 of them stopped answering the questions. From that point on the number of respondent slowly stabilized at 42 persons.



***4-3* Number of respondents from the start to the end of the questionnaire**

Although the questionnaire is anonymous, the inquirers asked whether respondents would voluntary leave behind some personal data such as the country they work in. From the respondents who completed the questionnaire 65% of the people filled out this personal data, which is presented in figure *4-4*. In this figure one sees that respondents from 14 countries left their country information. Most of these countries are in the northern part of Europe. Contacts in other countries did not react or reacted anonymously. Among them are also large countries like France and Italy.

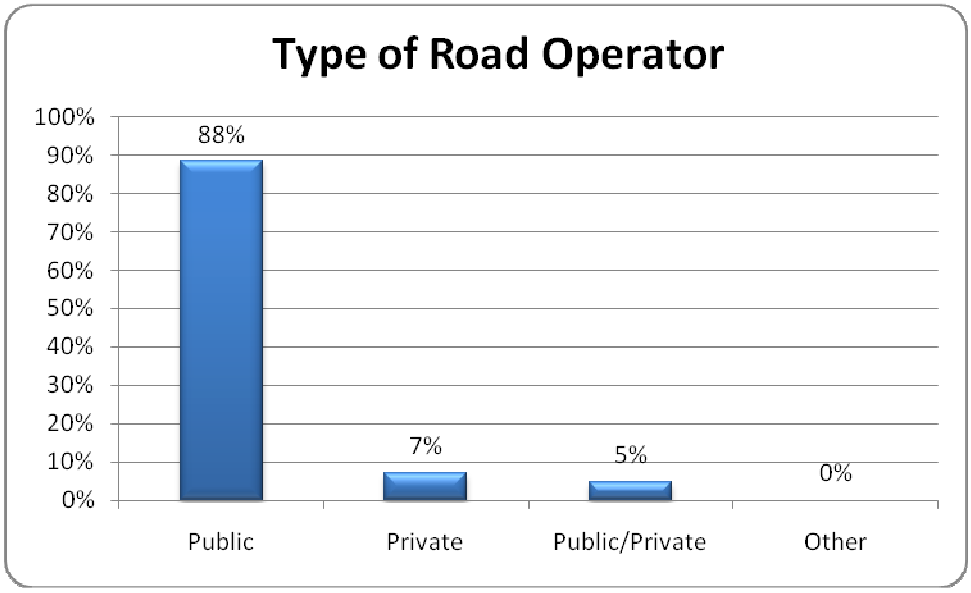
The relatively big percentage of respondents from the Netherlands is a result of the big number of contacts in the Netherlands to whom the questionnaire was sent directly. See also figure 5.1. Comparing figure 5.1 and 5.4 shows also, that the respondents from at least two countries (Croatia and Slovenia) were a result from the indirect distribution of the questionnaire. Respondents in these countries were not approached directly by RWS.



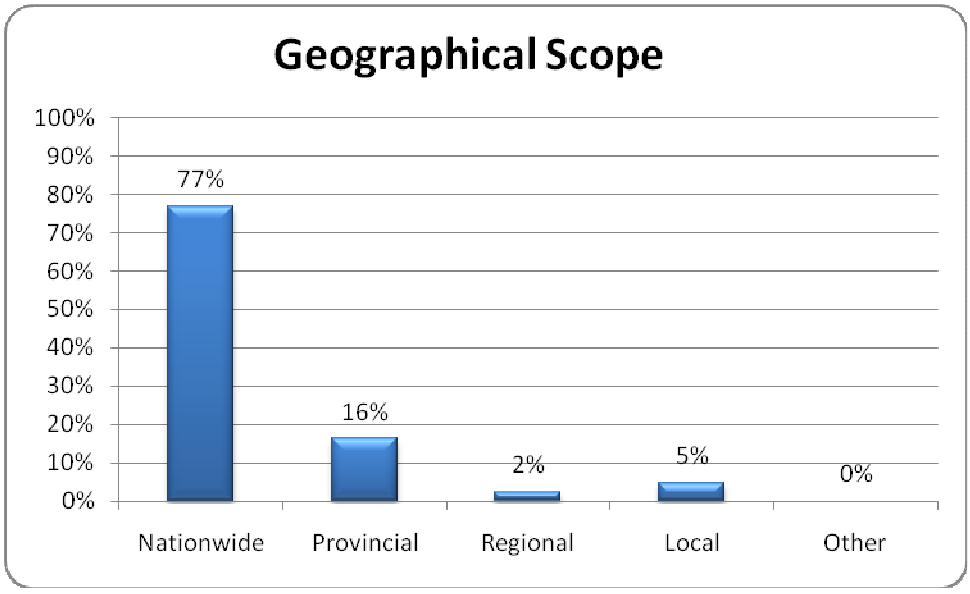
***4-4* Responses per country**

4.2. Type of road operators

In order to get a profile of the surveyed road operators for which the respondents work, there were some general questions in the questionnaire on the type of organisation and their working area. In 88% of the cases the road operator appeared to be a public organisation, 7% is privately owned and 5% is a mixed public/private organisation (see figure ***4-5***). A large majority of the organisations operate at a national level (77%). In the survey were few respondents from a local road operator (5%) (see figure ***4-6***).



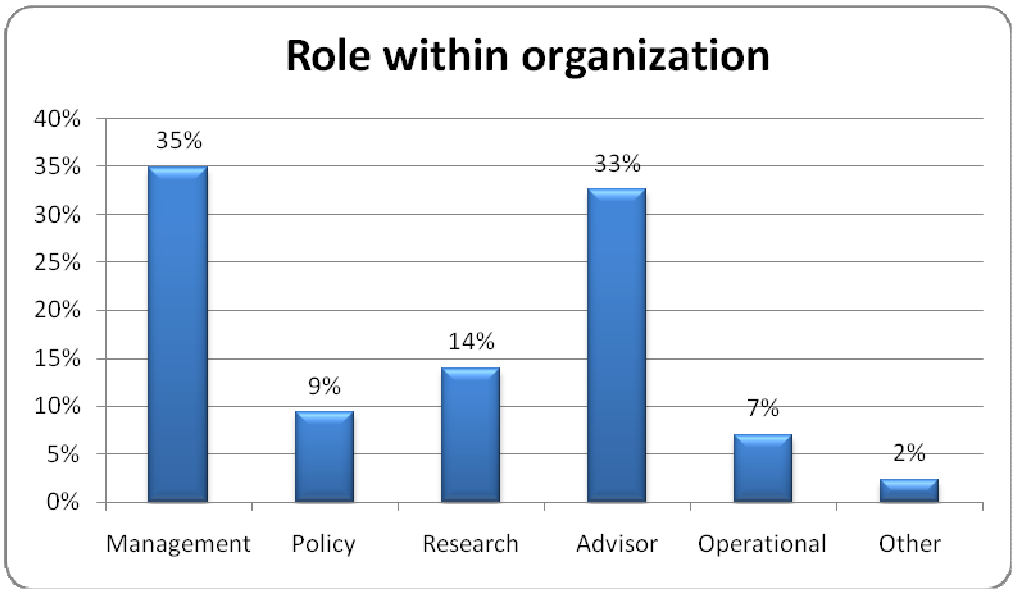
4-5 **Type of road operator**



4-6 **Working area of the road operator**

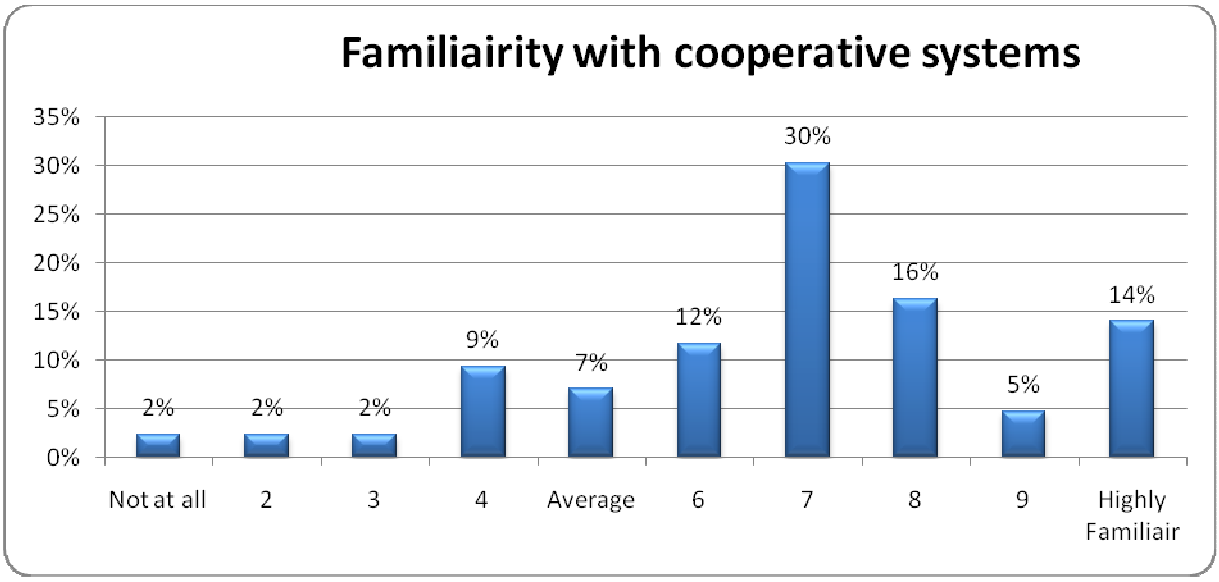
4.3. Characteristics of the respondents

Asked for their role in the organisation, about one third of the respondents indicates to be manager (35%), about one third advisor (33%) and about one third other roles (see figure ***4-7***). A large majority of the respondents has over 6 years experience in a road operator organisation (77%); 12% has 3 to 6 years experience and 12% less than 3 years experience (see figure 4-8) About three-quarters of the respondents (77%) indicate to have a more than average familiarity with cooperative systems (score 6 to 10 on a 1-10 scale). About one third (30%) indicates 7 on the 1-10 scale; 14% indicates the highest familiarity (see figure *4-9*).



4-7 **Role of the respondents in the organisation**

4-8 Years of professional experience in a road operator organisation



***4-9*Familiarity with cooperative systems**

4.4. Résumé

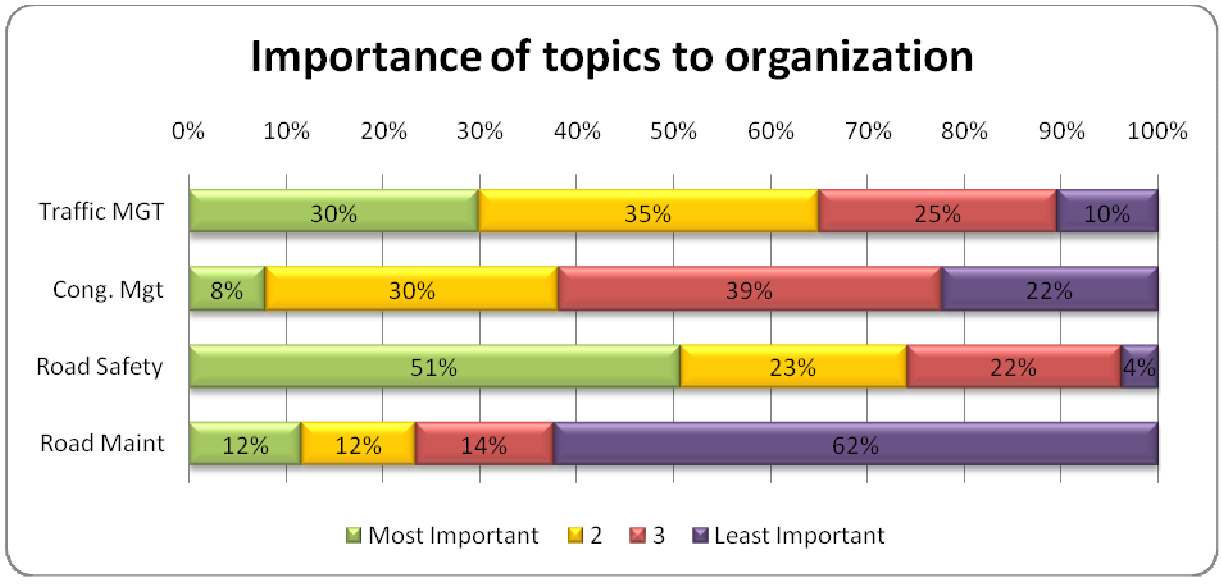
- Over 200 contacts from road operators in 24 European countries directly received an invitation to fill out a questionnaire. In addition probably at least the same number received such an invitation indirectly.
- Totally 174 contacts visited the website with the questionnaire and 42 completely filled it out.
- The majority of the respondents work for public road operators (88%) and operators working nationwide (77%).
- Approximately one third of the respondents are managers (35%) and one third are advisors (33%). Over 75% have more than 6 years of experience within a road operator organisation, while about the same percentage indicate to have above average familiarity with cooperative systems.

5. Topics

In order to gain an insight in the issues that are the most relevant to road operators, a number of topics were presented in the questionnaire. The respondents were asked to rank these topics, considering their relevance to their organisation. Respondents could also add other relevant topics. After ranking the topics, the respondents were requested to answer questions on the present use of intelligent or cooperative systems for these topics and the potential role of cooperative systems in future.

5.1. Importance of the topics

The inquirers asked the contacts to rank the topics traffic management, congestion management, road safety and road maintenance. This ranking shows, that the respondents consider road safety by far the most important topic for their organisation. The majority of the respondents (51%) rank this topic as the most important of all. About a third (30%) of the respondents ranks traffic management as the most important topic, 12% road maintenance and 8% congestion management. When considering the first and second places of the ranking (together) , one finds the same order for road safety (51+23=74%) and traffic management (30+35=65%), but congestion management (8+30=38%) and road maintenance (12+12=24%) exchange places (see figure 5-1).

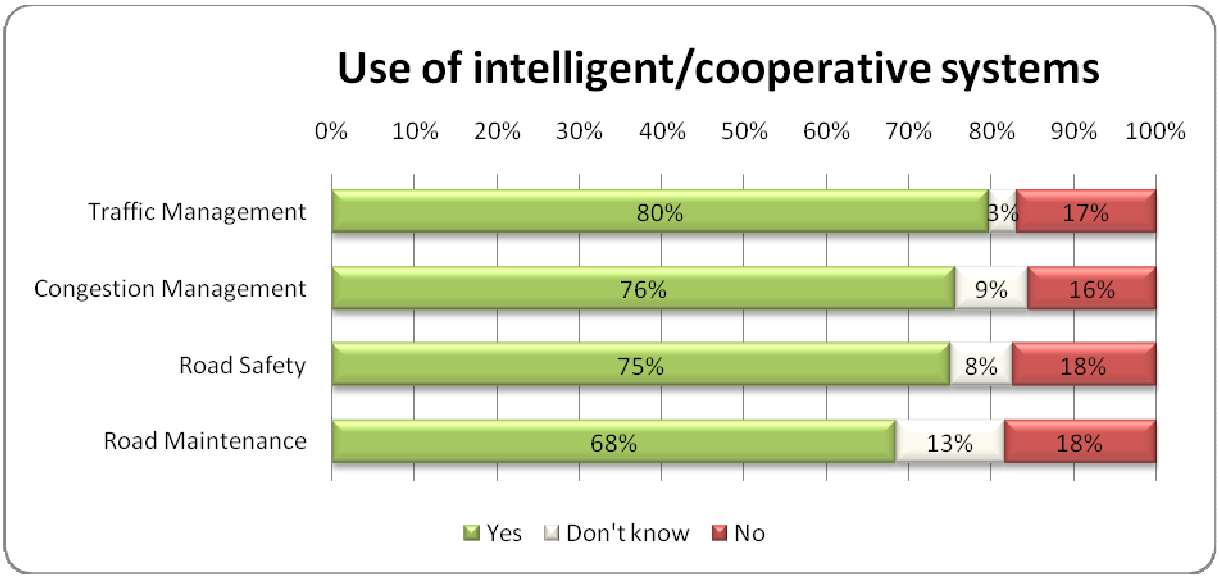


5-1 Importance of topics

A number of respondents mentioned extra topics, relevant for the road operator: providing traffic/customer information (9 times), environment (3 times) and incident management (twice). Some respondents made remarks concerning the definitions of the topics.

5.2. *Present use of intelligent/cooperative systems*

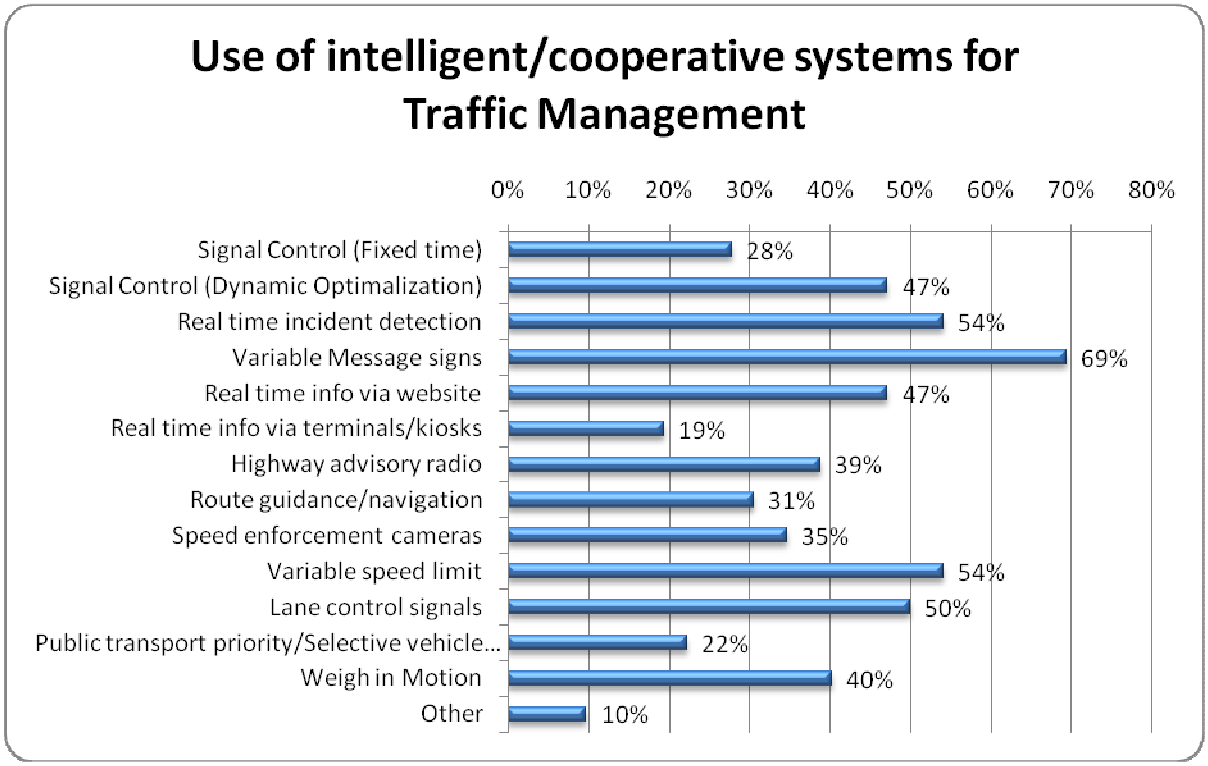
A large majority of the respondents indicate that intelligent/cooperative systems are already in use in their organisation. The highest percentage (80%) is found for traffic management purposes, the lowest for road maintenance (68%); see figure 5-2.



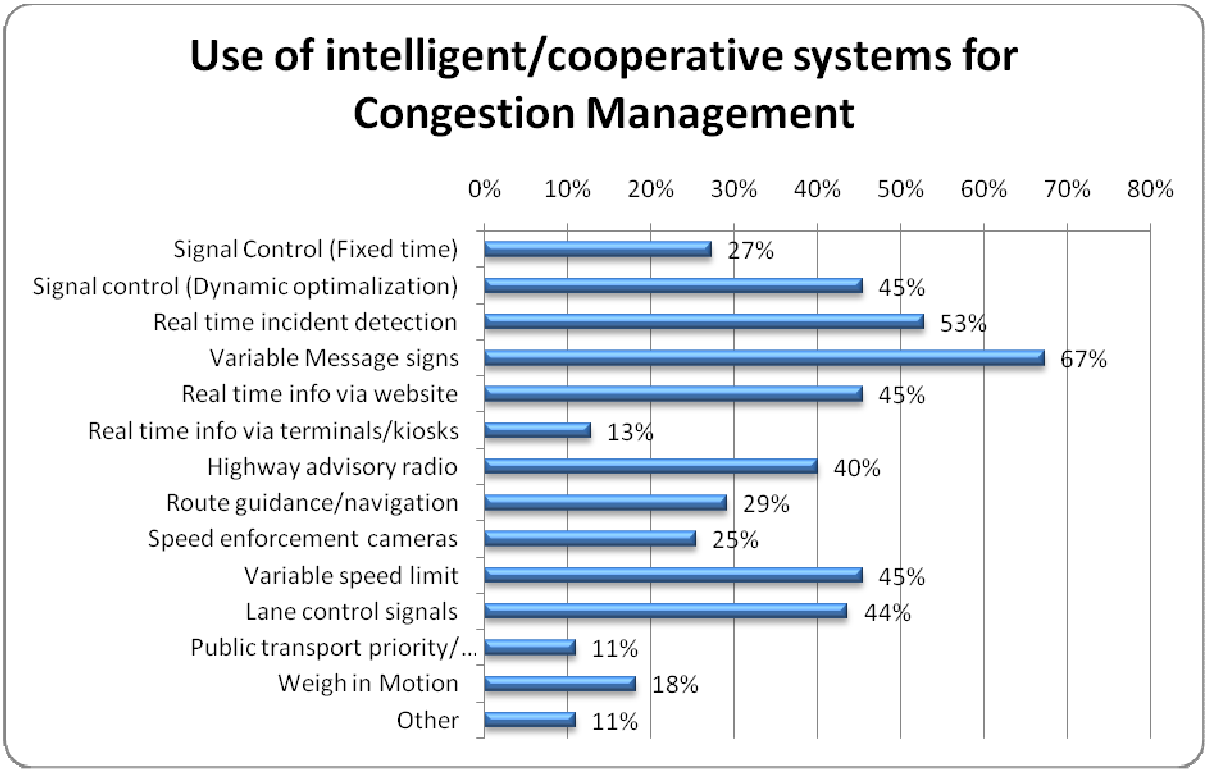
5-2 Use of intelligent/cooperative systems

The mostly used systems for all purposes are signal control with dynamic optimalisation, real time incident management, variable message signs, real time information via websites, variable speed limits and lane control signals. Except for road maintenance about 40% or more of the respondents mention these six systems (see figure 5-3, 5-4 and 5-5). For road maintenance (see figure 5-6) the respondents also often mention variable message signs (50%) and lane control signals (40%). The percentage of the respondents mentioning variable speed limits and real time info via websites for road maintenance are somewhat lower (36% and 34% respectively) and the percentage mentioning signal control with dynamic optimalisation and real time incident detection substantially lower (16% and 22% respectively).

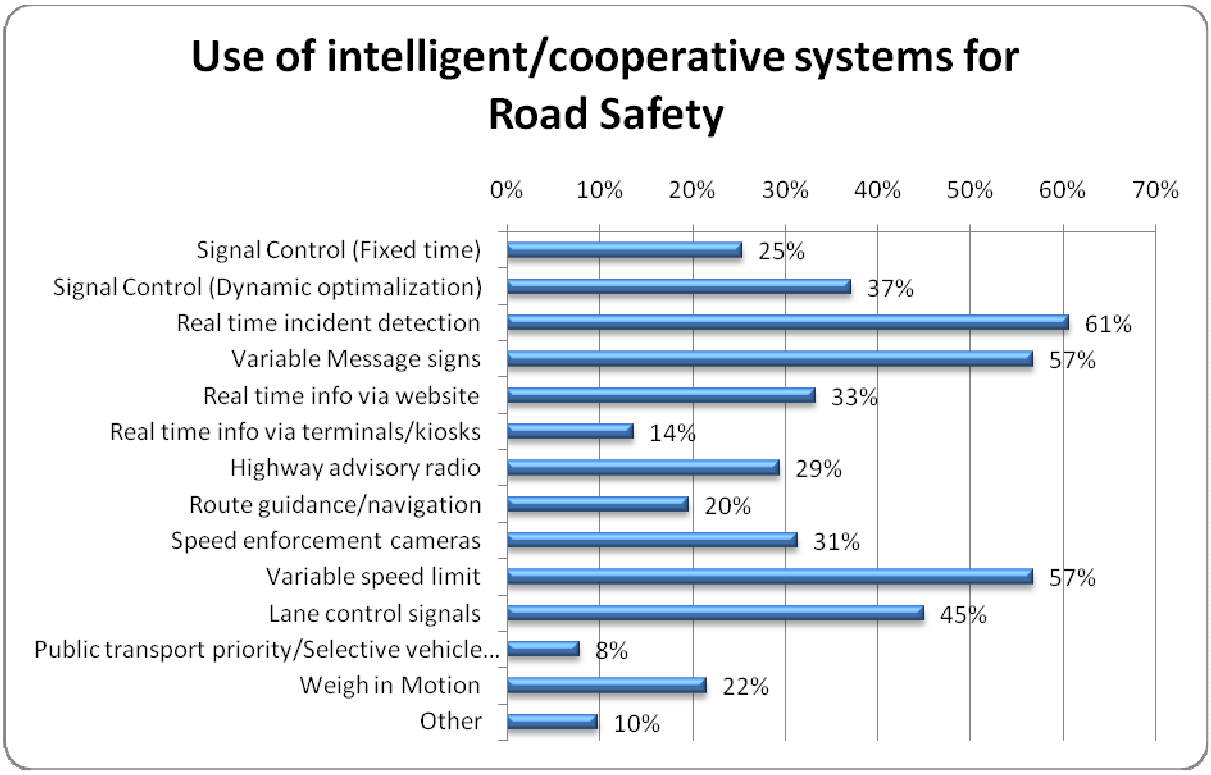
From the six systems mentioned above variable message signs are the most popular instruments for traffic management (69%), congestion management (67%) and road maintenance (50%). Also for road safety many respondents indicate the use of variable message signs (57%), but for this purpose real time incident detection (61%) is the system the most mentioned.



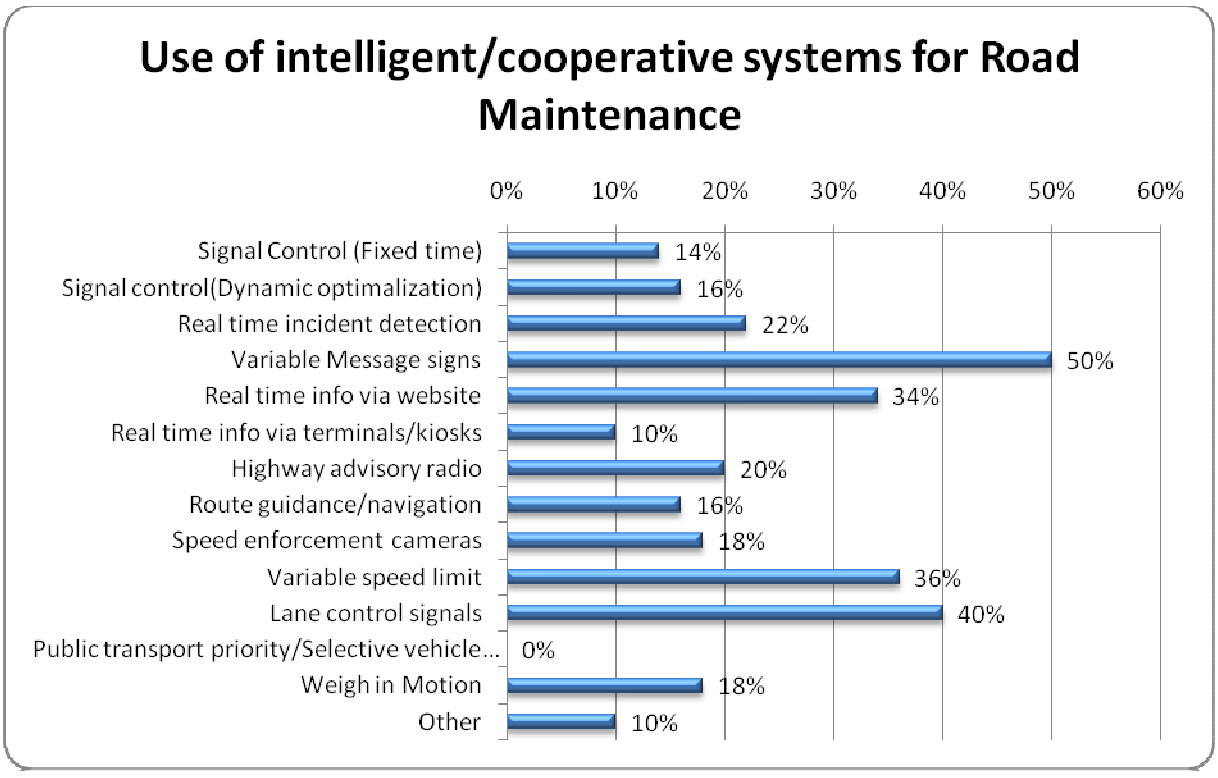
5-3 Intelligent/cooperative systems in use for traffic management



5-4 Intelligent/cooperative systems in use for congestion management



5-5 Intelligent/cooperative systems in use for road safety



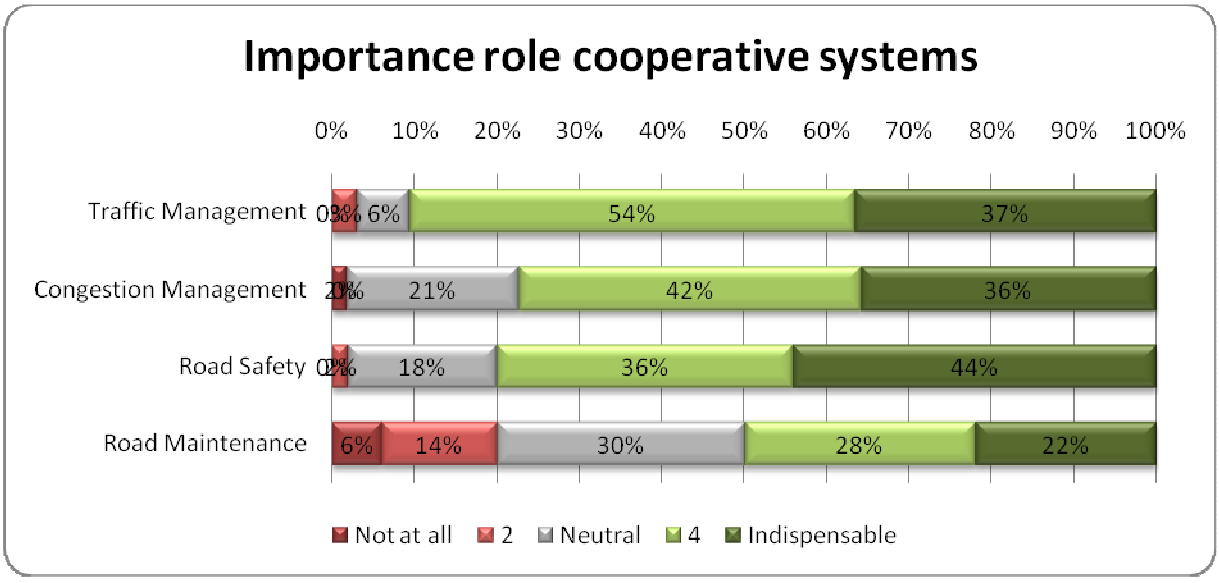
5-6 Intelligent/cooperative systems in use for road maintenance

The respondents often mention ramp metering as another system that is used by their organisations (11 times). Other systems mentioned concern temporary use of the hard shoulder, management of long distance corridors, dynamic road marking, travel time information, section speed control, cameras, real-time information by telephone, automated detection of the road condition and floating car data (FCD) for slippery roads.

5.3. Potential role of cooperative systems in future

A large majority of the respondents (see figure 5-7) indicate that cooperative systems can have an important role in traffic management (54+37=91% !!!), congestion management (42+36=78%) and road safety (36+44=80%). Regarding the use of cooperative systems for road maintenance the percentage of respondents giving a positive answer is lower (50%), Nevertheless, also in this case the number of respondents reacting in a negative way is still rather small (20%; 30% neutral).

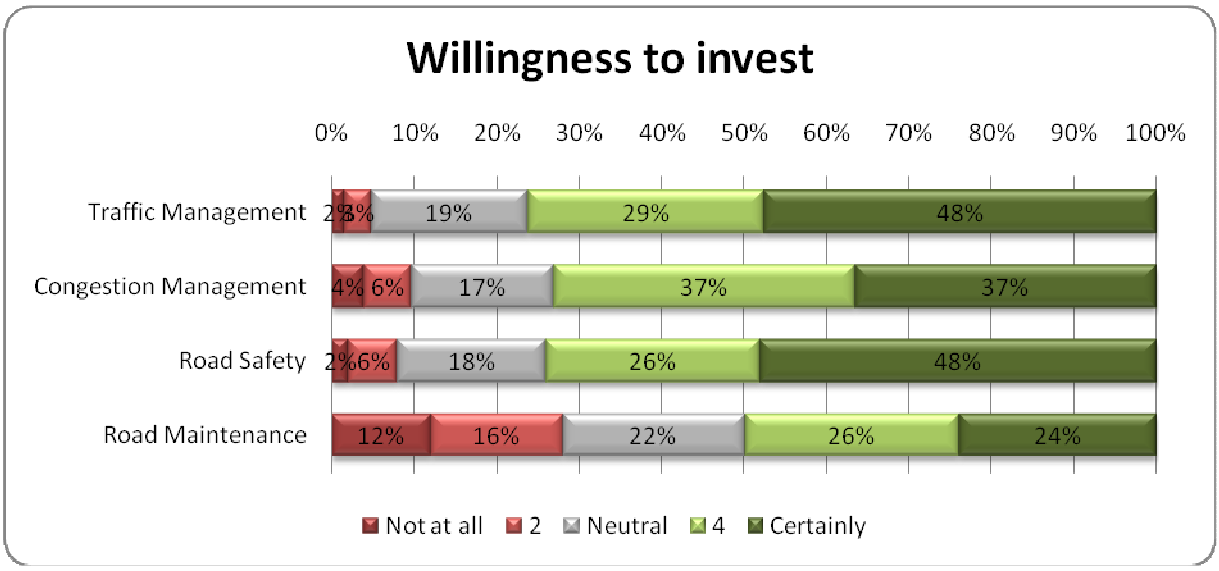
About one third of the respondents even sees cooperative systems as indispensable. For road safety this percentage is even higher (44%); for road maintenance lower (22%).



5-7 Importance of the potential role of cooperative systems

Although respondents are not as positive about the willingness to invest in cooperative systems than about the importance of these systems, there is still a large majority indicating that they are willing to invest (see figure 5-8). About three-quarters of the respondents indicate that they are willing to invest in systems for traffic management (77%), congestion management (74%) and road safety (74%). Half of the respondents indicate that they are willing to invest in cooperative systems for road maintenance.

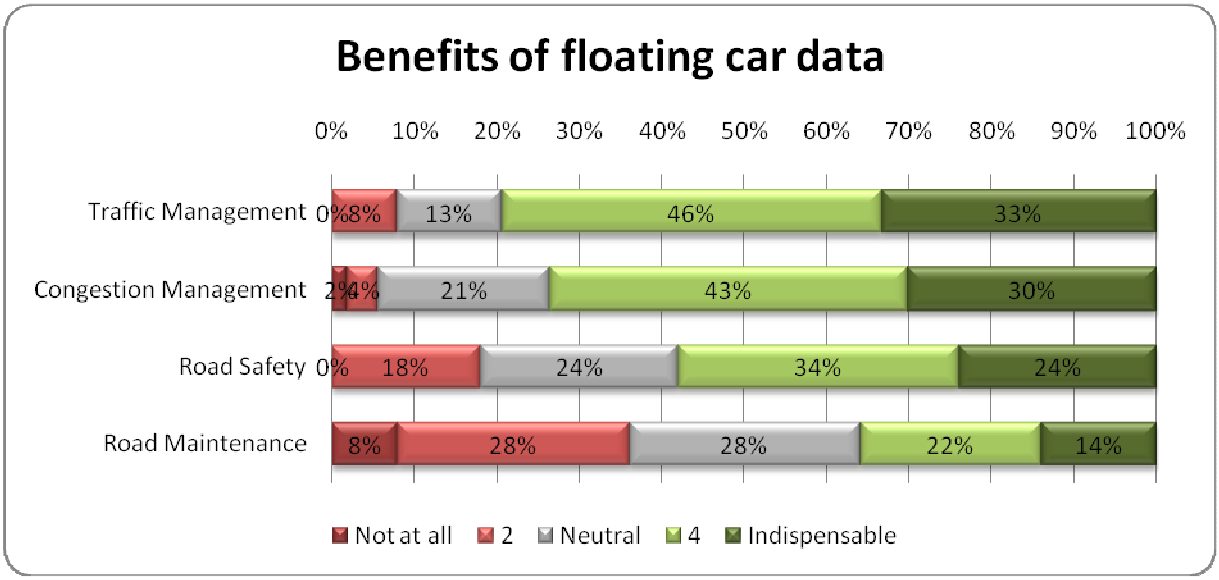
Almost half of the respondents state that they are 'certainly' willing to invest in cooperative systems for traffic management (48%) and systems for road safety (48%). For congestion management and road maintenance these percentages are lower (37% and 24% respectively).



5-8 Willingness to invest in cooperative systems

For most of the topics the majority of the respondents thinks that floating car data would be beneficial (figure 5-9). For traffic management and congestion management about three-quarters of the respondents state that floating car data would be beneficial, while about one third indicates 'certainly' beneficial. For road safety and road maintenance these percentages are lower: totally 58% positive from which 24% indicate 'certainly' beneficial and 36% positive from which 14% 'certainly' beneficial respectively.

For road maintenance the opinions on the benefits of floating car data differ the most. Opposed to the 36% of the respondents who are positive, there are 34% negative about the benefits of floating car data for road maintenance (28% neutral).



5-9 Benefits of floating car data

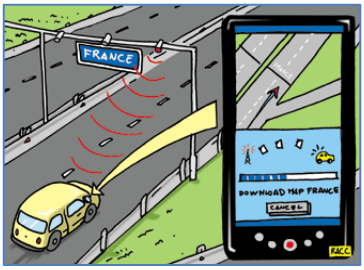
5.4. Résumé

- The respondents to the questionnaire consider road safety as the most important topic for their organisations. The topic traffic management is at a second place. In comparison to these two topics congestion management and road maintenance are considered as less important.
- A large majority of the respondents indicate that intelligent/cooperative systems are already in use in their organisation. The highest percentage (80%) is found for traffic management purposes, the lowest for road maintenance (68%).
- The mostly used systems for all purposes are signal control with dynamic optimalisation, real time incident management, variable message signs, real time information via websites, variable speed limits and lane control signals. From these systems variable message signs are the most popular for almost all purposes.
- A large majority of the respondents indicate that cooperative systems can have an important role in traffic management, congestion management and road safety. About three-quarters of the respondents is also willing to invest in systems for these purposes.

6. CVIS Applications

The inquirers presented nine examples of cooperative applications with questions on the benefits to road traffic, usefulness to road operators, willingness to invest in the application, etc. This chapter presents the results of these questions per application.

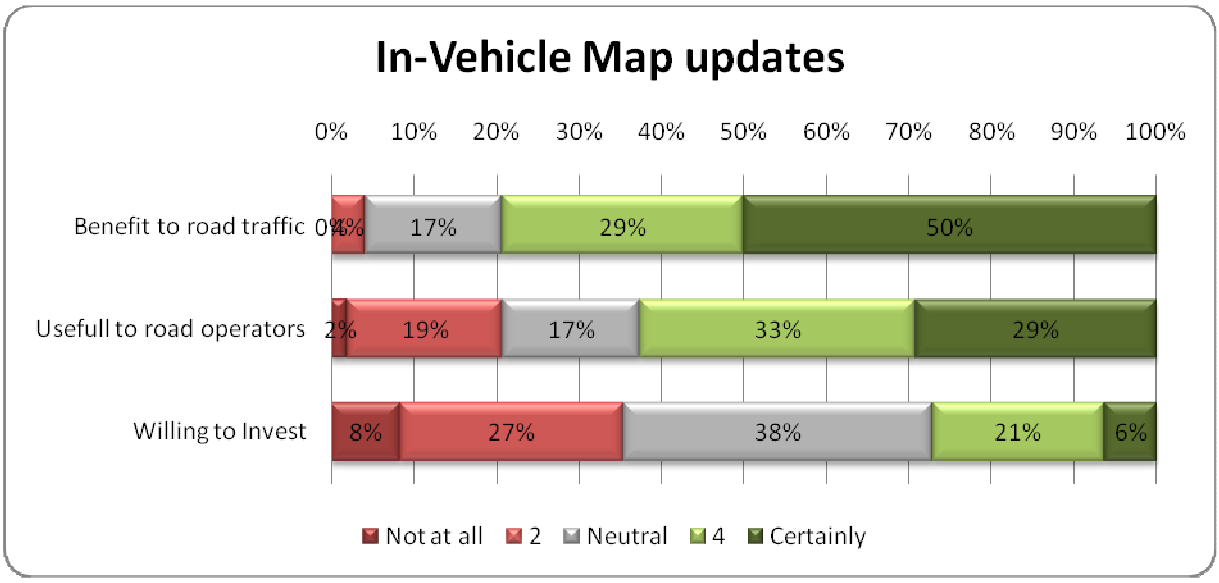
6.1. In-vehicle map updates



Goal: To receive map updates and live traffic or road infrastructure reports, along with other relevant local information views in cars.

The respondents consider the application 'In-vehicle map updates' as a useful application (see figure 6-1). A large majority (29+50=79%) thinks it is beneficial for road traffic, of which 50% indicates even 'certainly'!

Respondents mention the benefits of such an application regarding well informing the driver (so that he can make better choices), avoiding congestion (also in case of accidents or road works) and improving road safety. They also mention the possibility to route traffic according to traffic management strategies.



6-1 Application In-vehicle updates

A majority (33+29=62%) thinks the application is also useful to the road operator. In this respect respondents mention especially the easy and fast transfer of information from road operator to driver (e.g. warnings for bad road conditions or road maintenance) and the possibility to guide the traffic on their network in order to avoid congestion or unsafe situations. Also providing information to specific vehicle classes was mentioned.

About the willingness to invest in the In-vehicle map update -application opinions differ. Roughly one-third (8+27=35%) is not willing to invest, one third is neutral (38%) and one third (21+6=27%) is willing. In their comments a number of respondents indicate that road operators (as one of stakeholders) should only do a part of the investment (e.g. the data collection, the facilities on the road, providing adequate information). Most comments seem to indicate that road operators see the relevance of the application, but do not want a leading role in the development ('business case for the private sector'[2]).

The requirements, which the respondents mention for the application, often concern the quality of the information given. The information should be up-to-date, reliable ('up-to-date digital maps are a pre-requisite'), relevant and be beneficial for road safety. Other items mentioned are the necessity of routing traffic according to the traffic management strategies, the necessity of good cooperation among road operators, the standardisation of equipment in Europe (including digital maps, communication and data transfer), the suitability of the information for specific vehicles ('no heavy vehicles to be routed on inappropriate routes') and the display in the vehicle of legal speed limits.

6.2. *In-Vehicle Internet/Mobile Office*

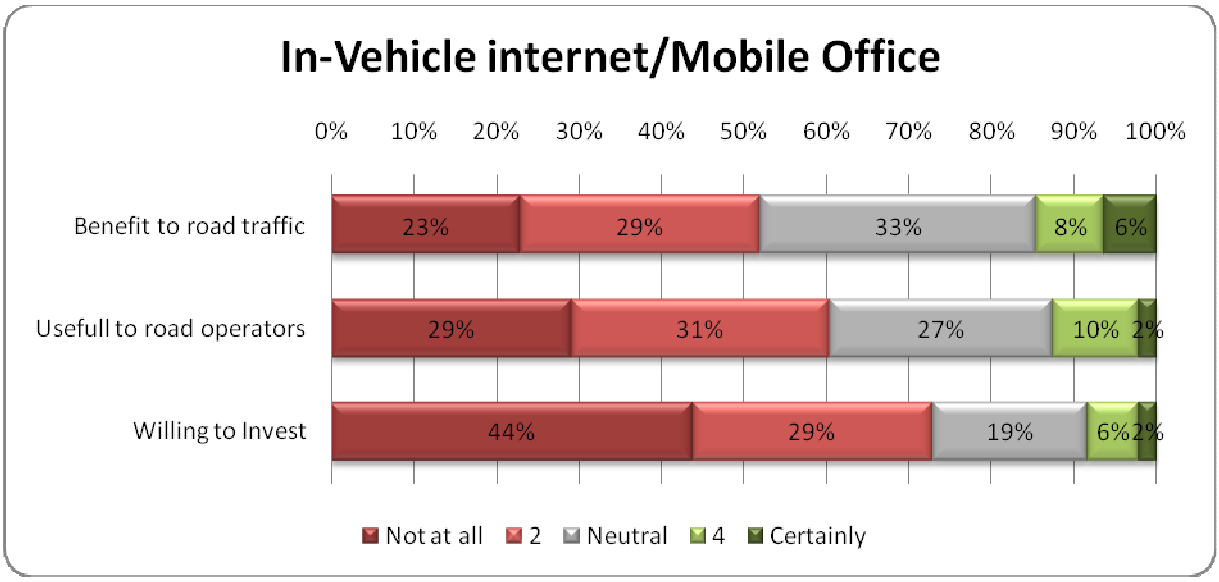
Goal: To provide internet services on board that can be used by the driver when the car is stopped or by passengers when the car is moving.

Only 14% of the respondents indicate that the In-vehicle internet/mobile office is beneficial to road traffic (see figure 6-2). In their comments most of the respondents indicate that they expect negative effects on road safety. The majority expects that drivers will be distracted too much. Some respondents mention the use of the application while driving: 'History learns that drivers are using these services not only when their cars have stopped (truck accidents, while the driver is doing other things than driving)'. Although not beneficial for road safety, some respondents think that the use of these or similar systems cannot be stopped: '…there are other options as well (mobile phones, blackberries). This will happen anyway, so there is not much to do…'

The question on the usefulness of this application gives similar results. Only 12% (10+2) consider the application as useful for the road operator. Although one respondent mentions the easy uploading of real time traffic information by the road operator, a number of

[2] The texts between quotation marks are quotes from the respondents.

respondents have strong doubts whether this information will be effective: 'Information on road conditions is more likely to reach the driver if tailored to the driver needs. Relevant, timely and accurate information is less likely to reach the driver, if the driver has to surf the web.'

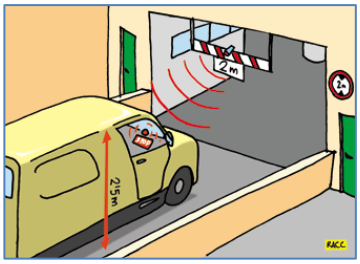


6-2 Application In-vehicle internet/mobile office

A small minority of the respondents (8%) indicates that they are willing to invest in the application. Some of the respondents mention in their comments that private parties will invest in this and that investments already have been done by providing information through the internet.

The question on the requirements for this system resulted in a comment from one of the respondents in which he stresses that it should be impossible to surf the internet while driving. Another respondent simply wrote: 'Do not implement them in cars'.

6.3. Obstacle Warning

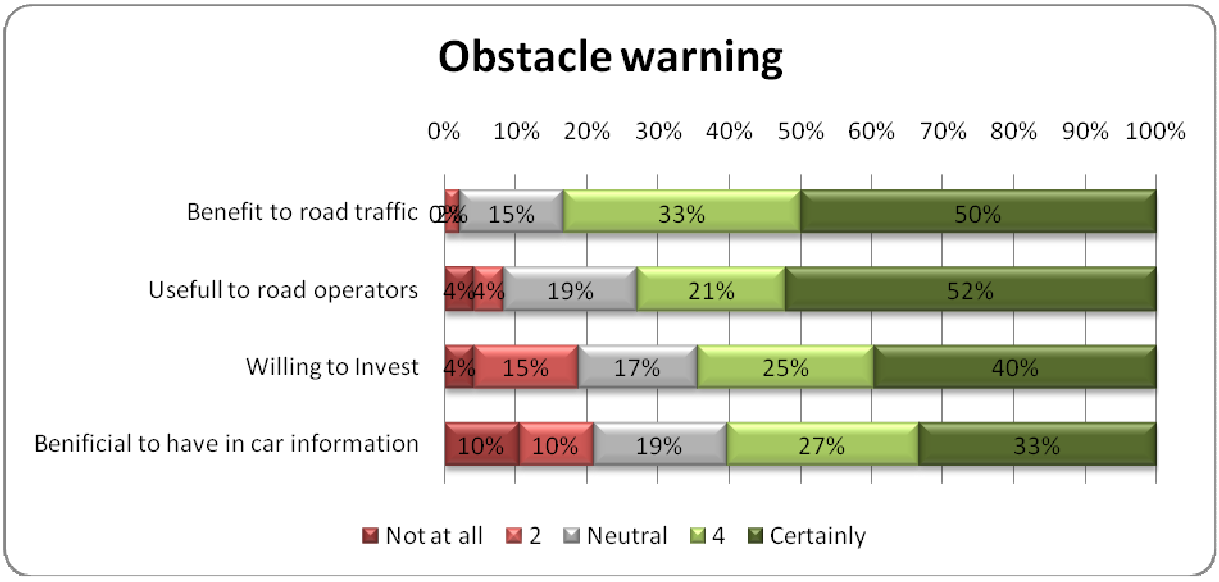


Goal: To increase driver's awareness of obstacles by receiving live information (e.g. video) from other vehicles or roadside units.

A large majority of the respondents is positive about the obstacle warning system; 83% (=33+50) thinks there are benefits for road traffic (see figure 6-3). Respondents mention that the system will prevent accidents, the congestion caused by these accidents and the

accompanying costs. Also the decrease of damage to highway infrastructure is mentioned. One respondent states that 'these applications are a must at tunnels', while another indicates that systems with similar purposes are already in use: 'we actually have a system working at the Velsertunnel (the Netherlands)'.

In accordance with the positive response regarding the benefits of the system for road traffic, the respondents also react in a positive way regarding the usefulness for their own organisation. About three-quarters (21+52=73%) of the respondents think the application is useful. With this respondents often mention the decrease of damage to the infrastructure.



6-3 Application Obstacle warning

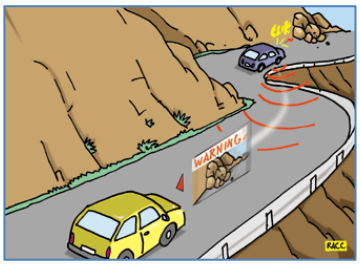
Most of the respondents (25+40=65%) indicate that they are also willing to invest in this application. A number of them indicate that their organisations already invested in such systems ('The UK has invested in this technology at the roadside. We would invest in providing relevant information to service providers.'). Others mention that road operators will only do a part of the investments ('as one of the stakeholders'), while one respondent mentions a 'long time for return of investment'.

A majority of 60% (33+27) of the respondents thinks it is beneficial that drivers get information in-car instead of from the roadside. In their comments respondents mention the advantages of in-car information ('better driver alert', 'in car has more impact because the warning is (physically) very near by'). However, a number of respondents mention that the information should not be in-car exclusively: 'use in-car information as well as roadside information'. Respondents with doubts on the positive impact of in-car information state that first evidence is needed 'to demonstrate that in-vehicle information would provide greater benefits than roadside equipment', that a 'perception of 'big brother' and 'police state' can arise among the public' and that 'there is a danger that driver behaviour will over time become immune to the additional impact of targeted information at their vehicle'. One respondent states that 'signs along the road will work just as good'.

On the question about the requirements for the application respondents mention 'reliability', 'accuracy', 'road safety' and warning in an early stage. One respondent mentions that the

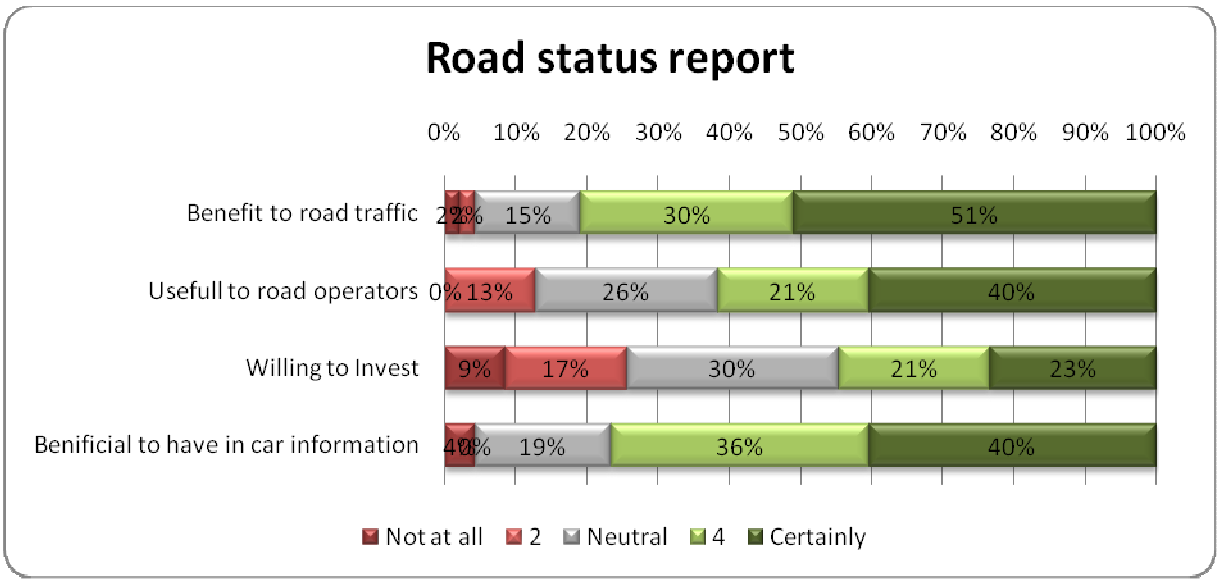
application should cover 'height-width-length-weight and turn radius in combination with length'. This respondent thinks it is also useful to have 'a proper route guidance along a suitable route for abnormal loads'. Another respondent states that special attention should be paid to bridges supporting railway tracks ('A number of old low bridges which support railway tracks are hid by high vehicles in the UK').

6.4. Road Status Report



Goal: To alert other drivers (and infrastructure) about road conditions / incidents (e.g. by image sharing and possibly by store and forward).

A large majority of the respondents (30+51=81%) indicate that the application road status report is beneficial to road traffic (see figure 6-4). A big part them (51% from all respondents) even indicate that it is 'certainly' beneficial. Most of the respondents mention positive effects on road safety, because drivers can be warned in a very early stage ('It takes some time before signs along or above the road are activated when an incident has happened. A signal from the car in front of you is quicker.').



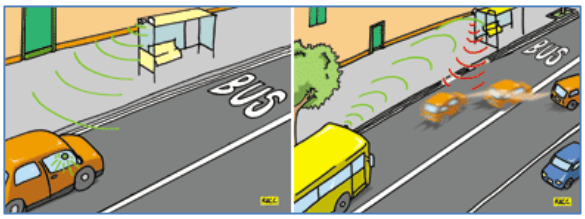
6-4 Application Road status report

Most of the respondents (40+21=61%) are also positive about the usefulness of the application for the road operator. Besides advantages for road safety, some respondents mention that by means of this application road operators will get a better knowledge of the current road condition.

Less than half of the respondents (21+23=44%) indicate that they are willing to invest in the application. A number of respondents see this application as a 'mainly car-related' system, 'not relevant to operator since this is vehicle-to-vehicle via ad-hoc networks' or have doubts about a positive cost/benefit ratio ('I think that the costs are high and the benefits are low'). Others mention that for road safety reasons some investments could be possible, if the road operator will get a clear role in the system.

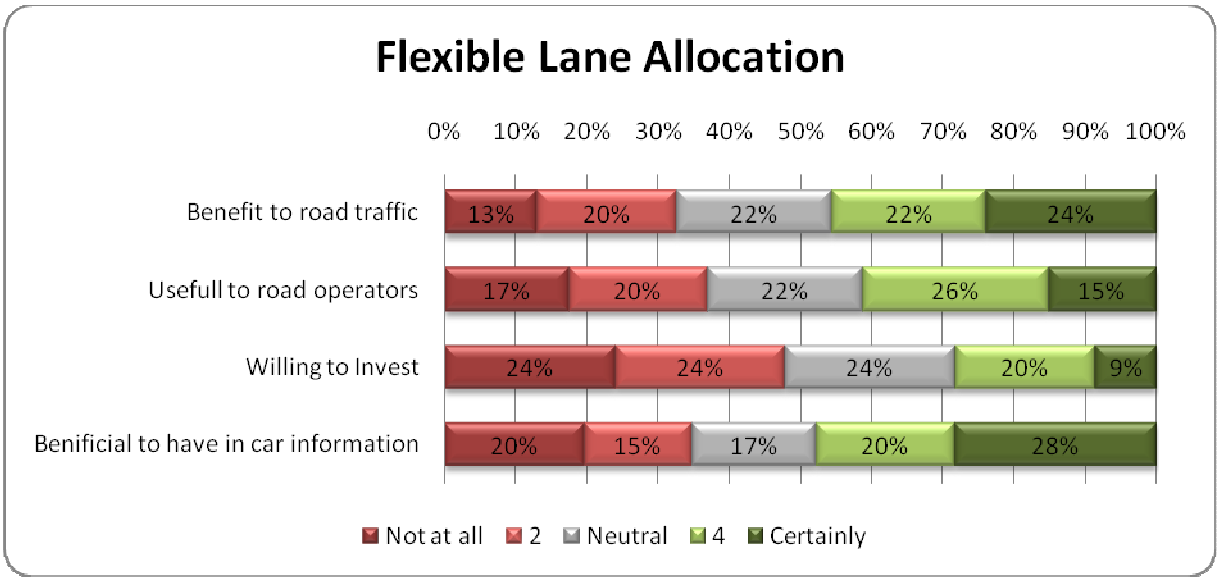
This role in the system a respondent also mentions regarding the requirements for the application. Concerning the requirements another respondent recommends that the application should also include 'the danger of aquaplaning'. He sees this as 'the most applicable item in daily road traffic'.

6.5. *Flexible lane allocation*



Goal: To increase the capacity on certain road sections in and around towns by allowing the use of bus lanes, without causing any disturbance to the public transport.

Opinions on the benefits of flexible lane allocation differ: 46% (22+24) of the respondents is positive about the benefits for road traffic, 22% neutral and 33% (13+20) negative (see figure 6-5). Respondents mention in their comments that there are not many places where this concept can be used, that it will not always be possible to leave the 'bus lane' if necessary and that they are afraid of abuse ('then we have the old problem back that urged us to institute free lanes'). In addition some respondents think right use will be very difficult to enforce ('I don't think it will work without extensive enforcement which is difficult as long as who proves the driver knew he was wrong.').

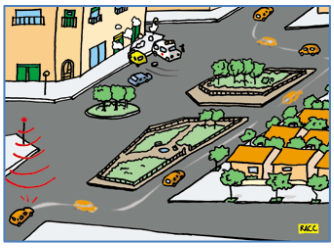


6-5 Application Flexible lane allocation

In line with the results above, opinions differ also on the usefulness of the application for road operators. Comments regarding this differ from 'it would create more problems than it would solve' to useful especially thinking of 'road freight transport now also demanding priority on select road corridors in urban areas'.

A minority of 29% (20+9) indicates that they are willing to invest in the application. One respondent comments that investment may be possible 'in a traffic management context so as to mitigate the impacts of excessive congestion on select vehicle classes. But not from the perspective to facilitating private car traffic.' The opinions of the majority of the respondents seem best to be reflected by the comment: 'there are several other applications which have higher impact on urban traffic flows'.

6.6. Area routing and control

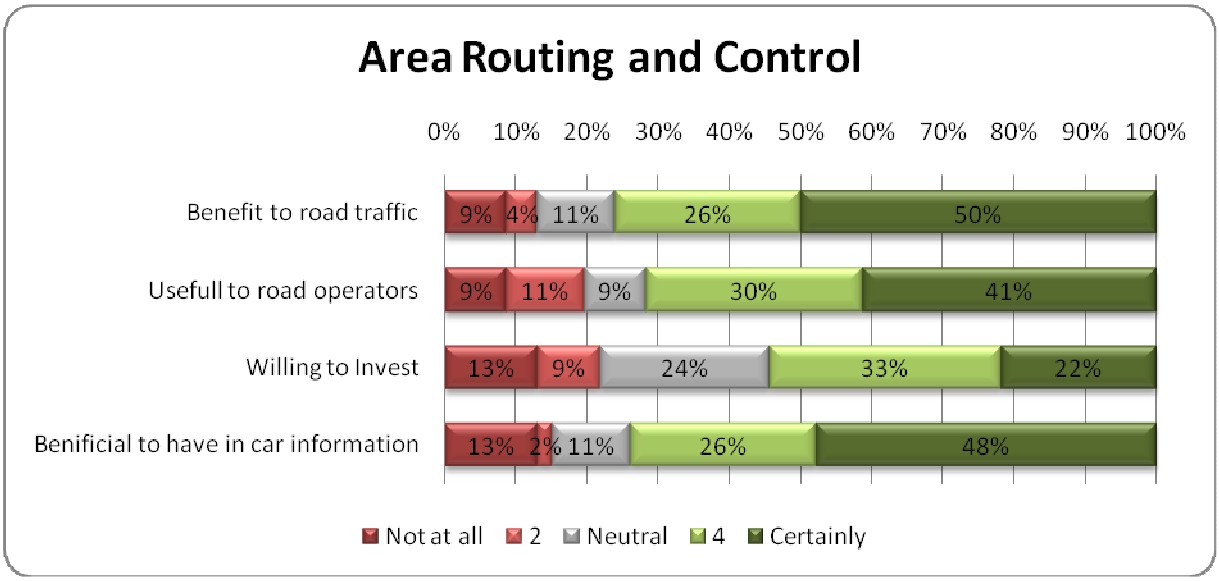


Goal: To offer alternative routes in towns in the event of an accident or incident.

About three-quarters of the respondents (26+50=76%) consider area routing and control as an application that is beneficial to road traffic; half of the respondents see it even as 'certainly' beneficial (see figure 6-6). Respondents mention advantages of the application like 'less delay', 'less congestion', 'maximum use of road capacity' (Japan mentioned as an example) and 'less irritation'. One respondent indicates that such a system will 'not necessarily' be beneficial. 'If the network is saturated, area routing will result in inappropriate use of minor roads along with breach of environmental regulations on noise, emissions, air quality, etc.'

Most of the respondents (30+41=71%) think the application is also useful for the road operator, while a small majority (33+22=55%) is willing to invest in the application. In their comments most respondents mention advantages of the system regarding traffic management ('less congestion through route guidance', 'easier to manage in case of incidents/traffic jams', etc.). Some comments regarding the investment by the road operator are: 'The social benefits are huge', investment 'as one of the stakeholders', 'investments in road features' and 'Perhaps, but important that commercial parties see this as a beneficial business case'.

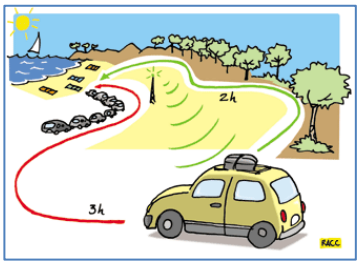
The respondents mention several requirements for the application: 'fast and early information', combination should be possible with 'route guidance for emergency vehicles and clearing routes for emergency vehicles' (like in Japan) and no re-routing of (heavy) traffic or dangerous goods through sensitive areas. Some respondents stress that 'spreading traffic on several alternative routes is vital for really good performance'. 'When you offer an alternative route where there's congestion as well, then the system won't work.'



6-6 application Area routing and control

About three-quarters of the respondents (26+48=74%) see benefits of the in-car display of information regarding this application. Respondents indicate that this is 'more flexible'. 'You'll have more options to reroute traffic when you get the information in the car. You can't have message signs everywhere'. The application can provide 'tailored information for each vehicle' with 'no costs for road side equipment'.

6.7. Cooperative traveller assistance (CTA)



Goal: To give support to drivers by planning a personalised route to follow, and to help the roadside manager to predict traffic congestion and delays.

By far the most respondents, (33+48=81%) see benefits of the application cooperative traveller assistance for road traffic (see figure 6-7). Advantages mentioned by the respondents are: better informed travellers so that they can make the right choices, a reduction of congestion and improvement of the reliability of estimated travel time.

About three-quarters (35+37=72%) of the respondents also see advantages for the road operator. Advantages mentioned in this respect are: good prospects for the transfer of information from the road operator to the road-user and the optimisation of the use of the network.

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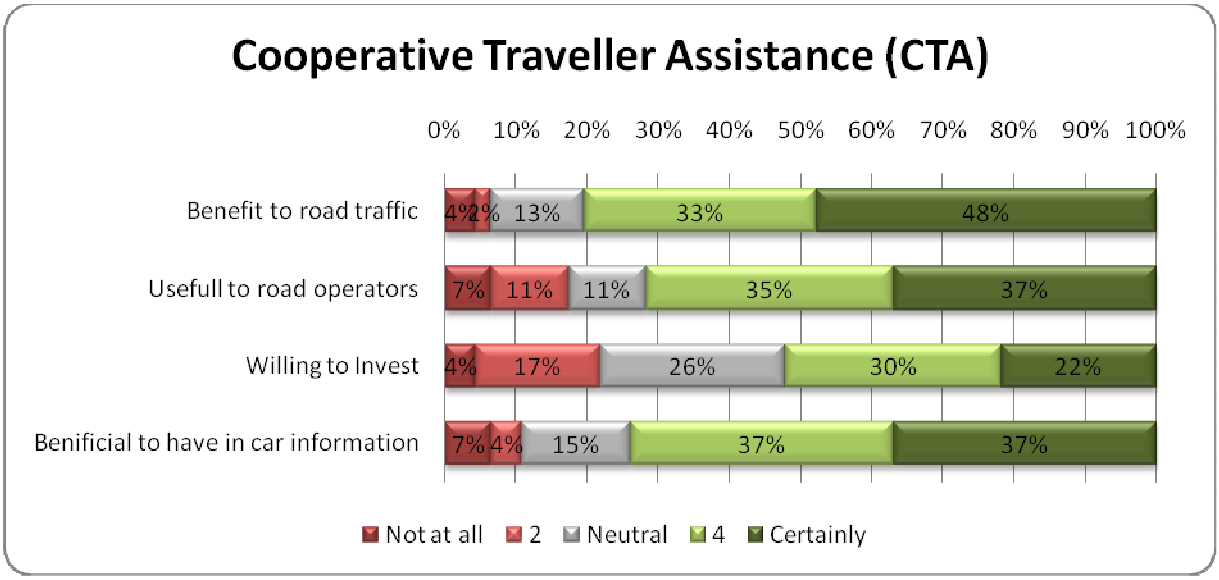


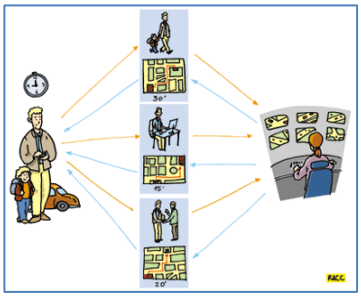
6-7 Application Cooperative traveller assistance

A small majority (30+22=52%) of the respondents is willing to invest in the CTA application. The comments from the respondents indicate that the investments will be partly ('as one of the stakeholders') and be focussed on delivering information on the status of the roads ('providing service providers with appropriate information and providing pre-trip planning services').

Regarding the requirements, in general the respondents indicate that the application should provide reliable real-time information to the road-user based on the current state of every main route in the network. The information should be including foreseen delays. One respondent suggests that the information should be for free: 'The ministry once developed a route planner on CD. You had to pay for it…'.

Most respondents (37+37=74%) see advantages of displaying the information in-car. A respondent states that there are 'more options when drivers get in-car information'. However, most comments indicate that this information should not be exclusively: 'information should be provided in-car as well as on the roadside'.

6.8. Personalized route planning based on expected travel time

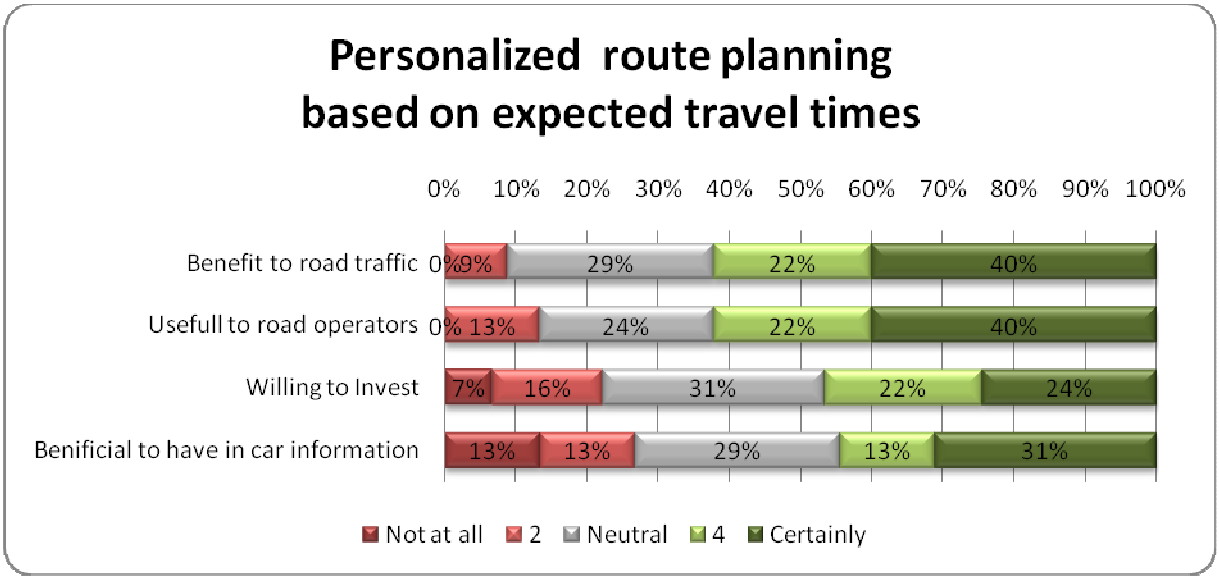


Goal: To provide drivers with a personalised route to follow and to help the roadside manager to predict traffic congestion and delays.

Most of the respondents think the application Personalized route planning is beneficial for road traffic as well as useful for the road operator (both 40+22=62% of the respondents, see figure 6-8). Although a part of the respondents have doubts about the feasibility of the application ('traffic is too dynamic to be predicted or forecasted' and 'seems a bit complicated'), most comments indicate that the extra information will be useful to predict traffic and in this way optimise the use of the road network ('the information about the intended travels can be very interesting for traffic management').

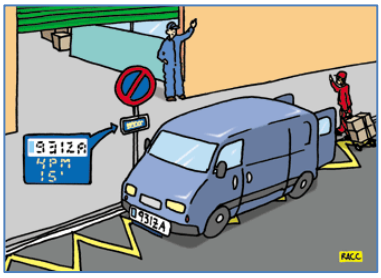
Almost half of the respondents (22+24=46%) are positive about investing in this application. One respondent mentions that 'eventually you can get huge social benefits from such systems'. Other respondents mention that their organisations already have invested.

A minority of the respondents (13+31=44%) thinks it is beneficial to provide information in-car. The application assists to plan activities. Before starting the trip information in-car is not necessary. In their comments most respondents mention that in-car information is only necessary when the travel advice changes on the road. One respondent states that the information should not be given 'in the car but on a mobile device!'



6-8 Application Personalized route planning

6.9. Urban parking zones



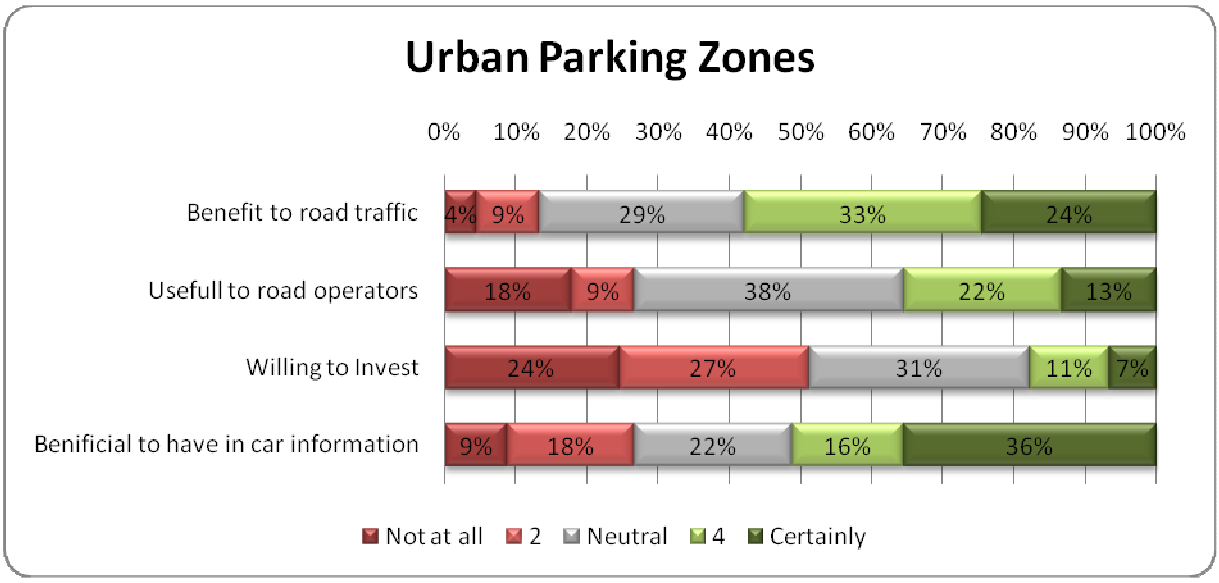
Goal: To allow advanced booking of urban parking lots (to professional and particular drivers).

A majority of the respondents (33+24=57%) think that the application Urban parking zones has benefits for road traffic (see figure 6-9). Advantages mentioned are: reduction of 'extra traffic movements to find parking places', 'less disturbance of traffic', 'predictability' and 'no need for parking meters, no need for cash cards', especially of use 'in highly occupied zones'.

About one third (22+13=35%) of the respondents see benefits of the application for the road operator and about half of them (18%) indicate that they are also willing to invest in such a system. Note that the large majority of the respondents are from national, provincial or regional road operators (and not from urban road operators; see chapter 4). This may have an important influence on the results. The respondents' comments also reflect this point. Some respondents mention the relevance of such an application for others ('more to parking management' and 'municipalities should do so'). Others mention that private parties should have a leading role in developing such applications ('has to be left to the market' and 'more a commercial thing'). One respondent mentions that for his organisation an application for 'parking places for trucks (rest areas)' along highways can be useful.

Requirements mentioned for the application concern the combination with route guidance, distinction of the type of vehicles ('a lorry has different parking requirements than a private car'), cooperation among stakeholders ('visitors of offices and companies can make reservations for parking') and the (fast) introduction of the system ('get it running quickly').

Regarding this application more than half of the respondents (52%) see advantages of giving the information in-car. Most of the respondents comment that, if the application provides individual (dedicated) information, in-car display is indispensable ('a must in this case').



6-9 Urban parking zones

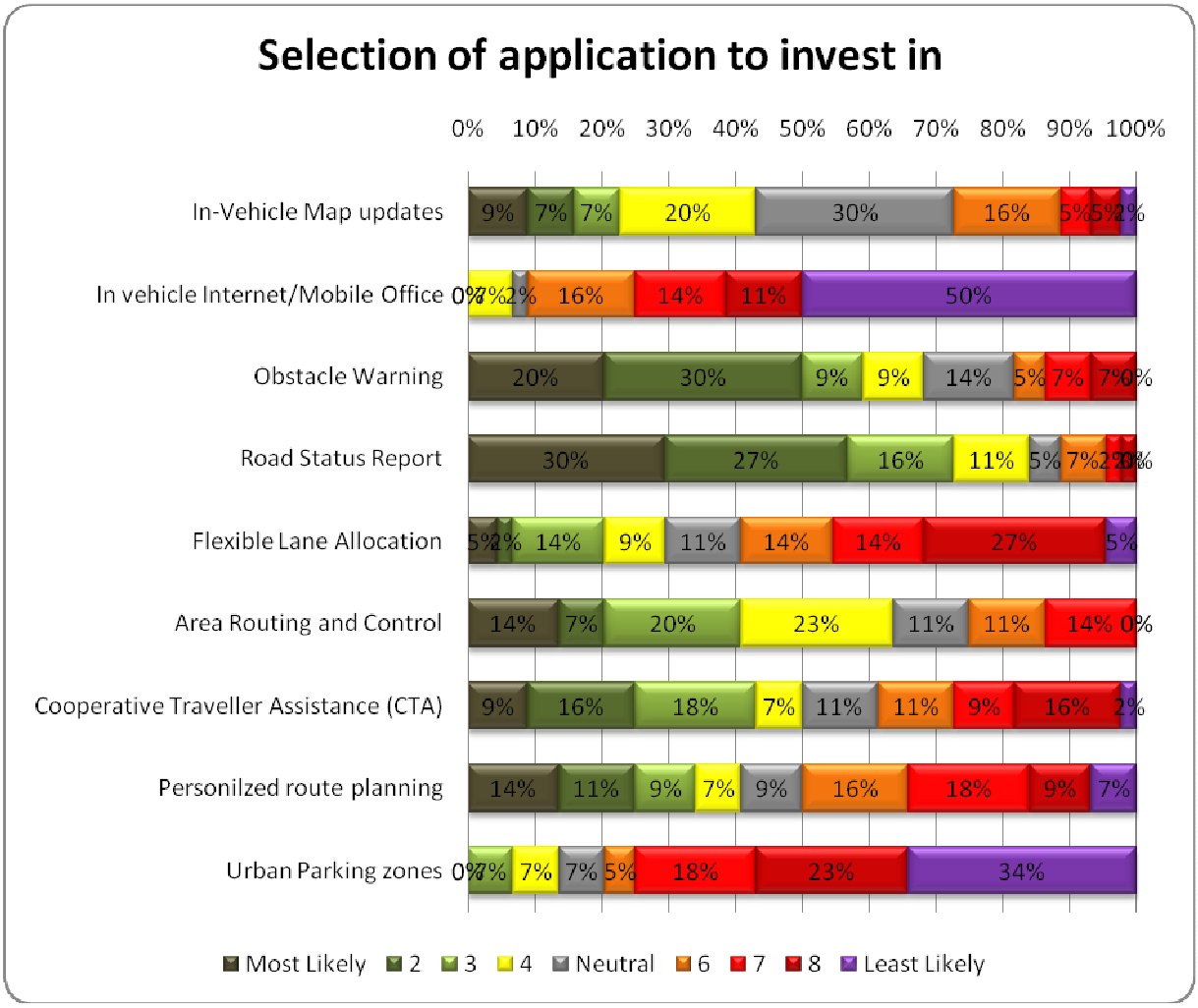
6.10. Comparison of applications

In order to make a comparison, the respondents were asked to select applications to invest in, by means of giving a ranking (1, 2, 3, etc.; 1=most likely). Figure 6-10 shows the results of this. In this figure one can see all applications with per application the percentage of respondents who ranked it at the first place, second place, etc. E.g. the application 'In-vehicle

map update': 9% of the respondents put this application at the first place, 7% at the second place, 7% at the third place, etc.

Looking at the ranking higher than average (i.e. respondents rank the application at the first, second, third or fourth place), the application Road status report has the highest score (30+27+16+11=84%). The application Obstacle warning has the second highest score (20+30+9+9=68%), followed by the applications Area routing and control (14+7+20+ 23=64%) and Cooperative traveller assistance (9+16+18+7=50%).

When looking at the applications that were ranked first or second, the applications Road status report and Obstacle warning again have the highest scores (30+27=57% and 20+30=50% respectively), but the order of the other applications changes. Both the applications Cooperative traveller assistance and Personalised route planning have the third highest score (9+16=25% and 14+11=25% respectively) followed by the application Area Routing and control (14+7=21%).

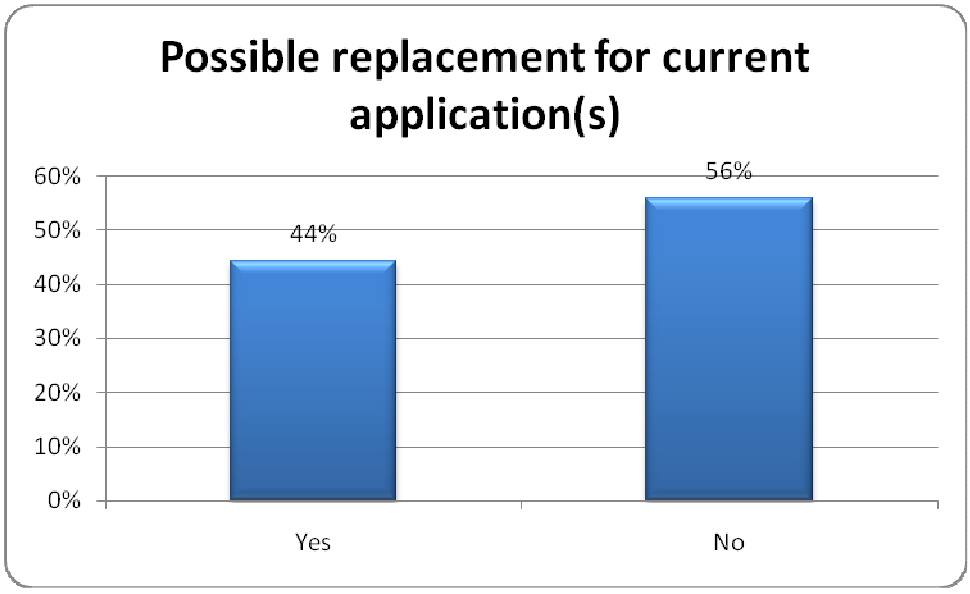


6-10 Selection of applications to invest in

The following list gives a complete overview of the order, looking at the ranking higher than average (between brackets the order when looking at the ranking at the first and second place).

1. Road status report (1);
2. Obstacle warning (2);
3. Area routing and control (5);
4. Cooperative Traveller Assistance (CTA) (3/4);
5. In-vehicle map updates (6);
6. Personalised route planning (3/4);
7. Flexible lane allocation (7);
8. Urban parking zones (8/9);
9. In-vehicle internet/mobile office (8/9).

The results of the ranking show that roughly three groups of applications can be distinguished. First there are the applications Road Status Report and Obstacle warning, which the road operators consider the most important. Then there is a middle category with the applications Area routing and control, Cooperative Traveller Assistance, In-vehicle map updates and Personalised route planning. Finally there is the group with the applications Flexible lane allocation, Urban parking zones and in-vehicle internet/mobile office, which find the road operators the least interesting or desirable to invest in.



6-11Possible replacement of applications

More than half of the respondents (56%) think that the applications presented, cannot replace existing systems used by operators at the moment. If respondents mention systems, which can be replaced by one of the applications, they are often obstacle warning, road signs ('road signs (signs are very expensive and travellers are less likely to adjust their behaviour, compared to information given in-car)') and variable message signs. A number of respondents mention that at the moment replacement is not possible, but in future it will be ('At present no, but as in-vehicle systems become widely available possibly yes.' and 'in the long run it can replace VMS signs but we talk 20 years ahead or so.').

When asked for additional applications useful for road operators, the respondents mention the following:

- incident detection and warning;
- road condition information;
- variable in-vehicle speed advice;
- combined information about road traffic, public transport and transfer points (P&R);
- intersection warning;
- weather status report (fog, heavy rain, etc.).

6.11. Résumé

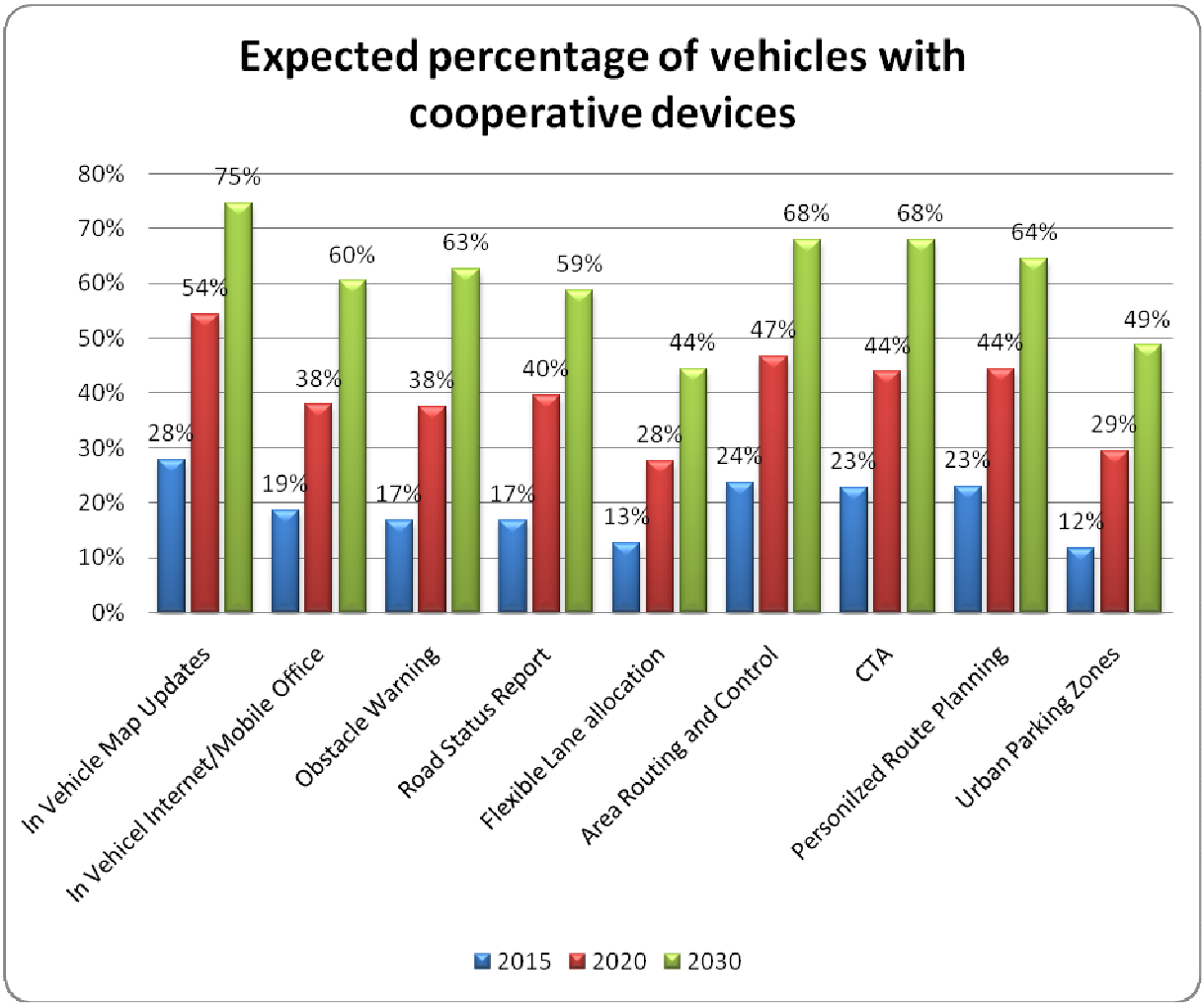
- Seven of the nine applications presented are considered beneficial to road traffic by a majority of the respondents (> 50%), while five of these are considered beneficial by even around 75-80% of the respondents. These five applications are: In-vehicle map updates, Obstacle warning, Road status report, Area routing and control and Cooperative Traveller Assistance.
- Six of the nine applications presented are considered useful to road operators by a majority of the respondents (> 50%), while three of these are considered useful by around 70-75% of the respondents. These three applications are: Obstacle warning, Area routing and control and cooperative traveller assistance.
- Four of the nine applications presented are considered worthy of investments by around half of the respondents (> 44%), while one of these is considered worthy by almost two third of the respondents (65%). This application is: Obstacle warning.
- In almost all cases a majority of the respondents consider it as beneficial that drivers dispose of information in-car. However, respondents often mention that the information should not be in-car exclusively. More than half of the respondents (56%) think that the applications presented, cannot replace existing systems used by operators at the moment.
- Based on a ranking by the respondents looking at the willingness to invest, the applications can be divided in three groups. The applications Road status report and Obstacle warning are considered the most important. The applications Area routing and control, Cooperative traveller assistance, In-vehicle map updates and Personalised route planning are in a middle category. The applications Flexible lane allocation, Urban parking zones and in-vehicle internet/mobile office are the least interesting or desirable to invest in.

7. Deployment

7.1. Expected implementation of cooperative systems

The respondents expect that in 2030 more than half of the vehicles is equipped with most of the nine applications presented (average values). The most popular applications are expected to be in around 60 to 70% of the vehicles. In 2020 about 40 to 50% of the vehicles will already be equipped with these applications and in 2015 around 15 to 20% (see figure 7-1).

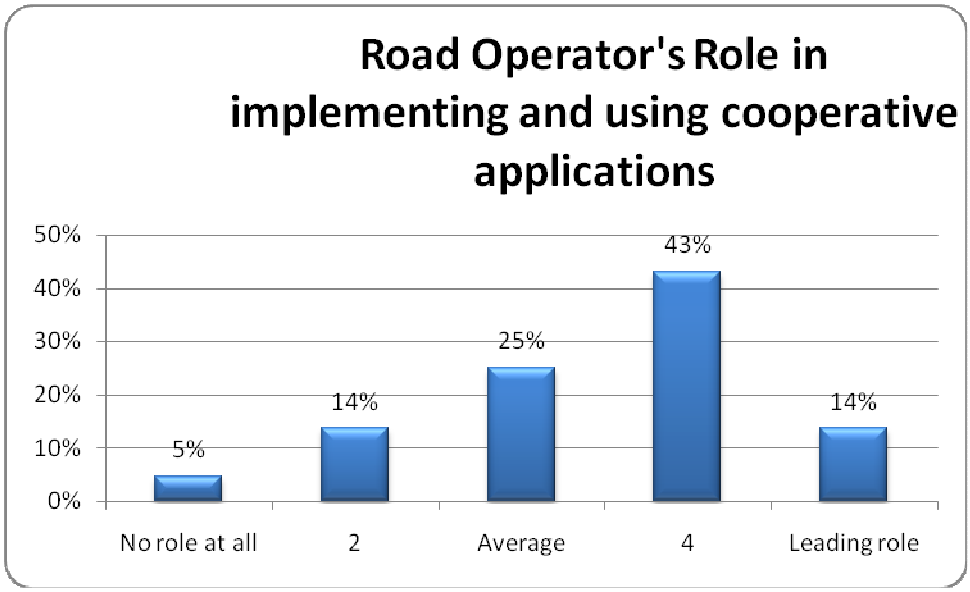
The respondents expect the biggest growth for the application In-vehicle updates: in 2015 almost 30% of the vehicles will have this application, in 2020 about 55% and in 2030 about 75%. Other applications with an expected big growth are Area routing and control, Cooperative traveller assistance and Personalised route planning (in more than 40% of the vehicles in 2020).



7-1 Expected implementation of applications

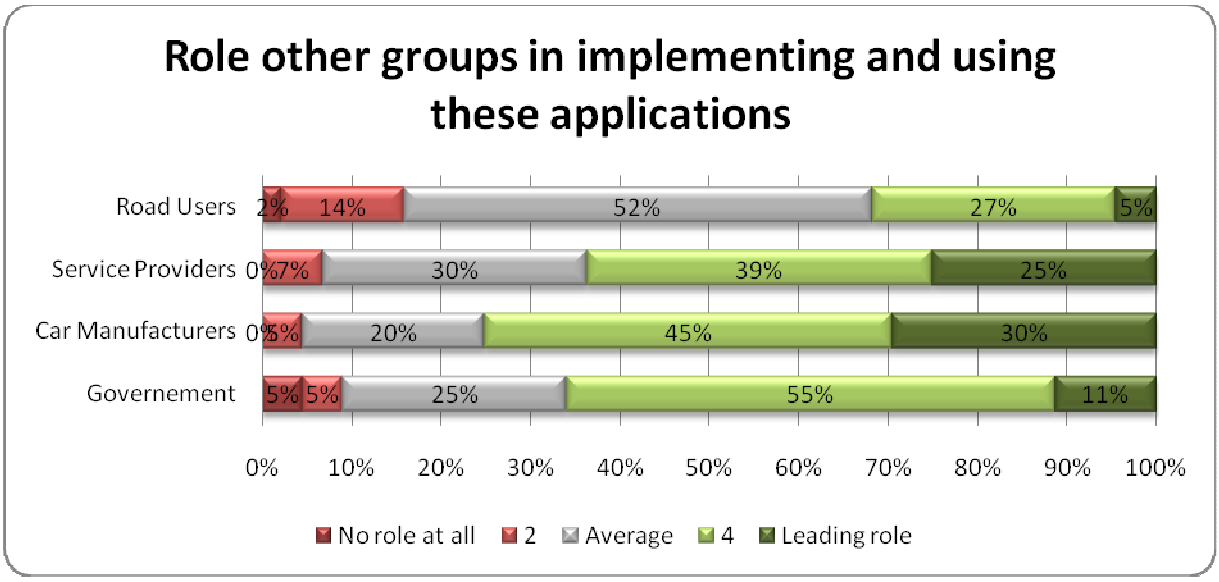
7.2. *Roles of stakeholders*

Over half of the respondents (43+14=57%) think that road operators have an important role in implementing and using cooperative applications; 14% sees even a leading role for road operators (see figure 7-2). However, the respondents think the role of most of the other stakeholders is even more important than the role of the road operator. Three-quarters of the respondents (45+30=75%) see an important role for the car manufacturers, 66% for the government and 64% for the service providers (see figure 7-3). Other stakeholders mentioned by the respondents are: ITS organisations, communication providers, information technology companies and radio/television.



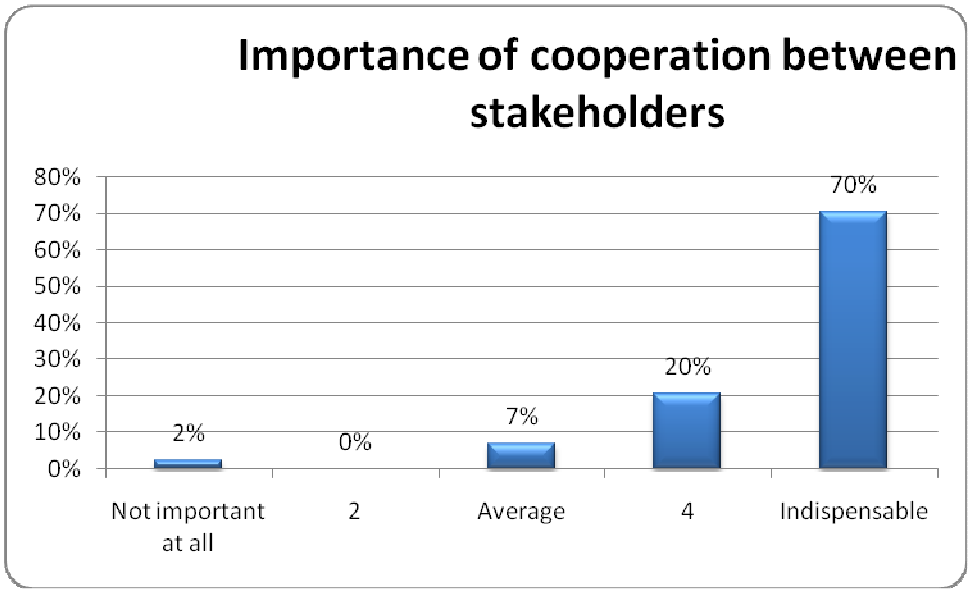
7-2 Road operator's role

In their comments some respondents stress that because in-car technology is car related, the car industry should have the leading role (and the government a role to 'pave the legal way for implementation, thus clearing barriers'). Others think it is not possible to designate a single stakeholder with a leading role ('all providers must work cooperatively to deliver advance safety, traffic management and efficiency benefits, no single player can implement alone'). Another respondent thinks a leading role for the car industry is not favourable: 'Information should be given by systems that aren't dependent to car manufacturers. 'Eventually governments and service providers are the partners you're looking for. Car-companies and it's systems are less flexible.' Also differences in interests are mentioned: 'commercial applications in the interest of manufacturers are not necessarily according to transport policy'.



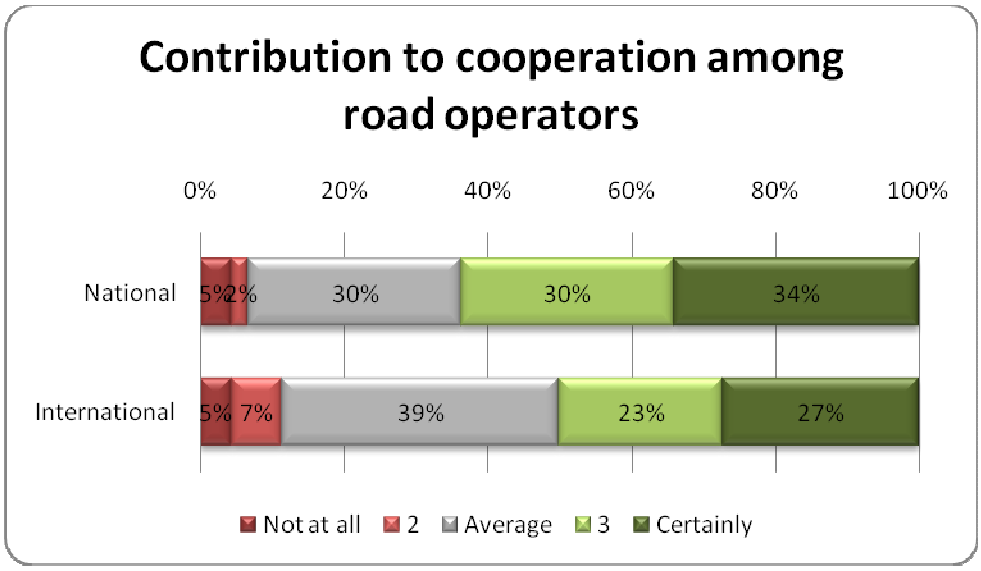
7-3 Roles of other stakeholders

The respondents are almost unanimous about the importance of cooperation among stakeholders: 90% thinks it is important, from which a very large majority even thinks it is indispensable (70% of all respondents, see figure 7-4). At the same time a number of respondents indicate that it is complicated to realise good cooperation among stakeholders ('the stakeholders differ very much'). This is probably an important reason for a slow deployment of systems ('Everyone is looking at each other without really doing anything. I think that many of the ideas that I saw in this survey are at least 10 years old. The development goes very slow, while the development of technology goes very fast. That's not good.') .



7-4 Importance of cooperation among stakeholders

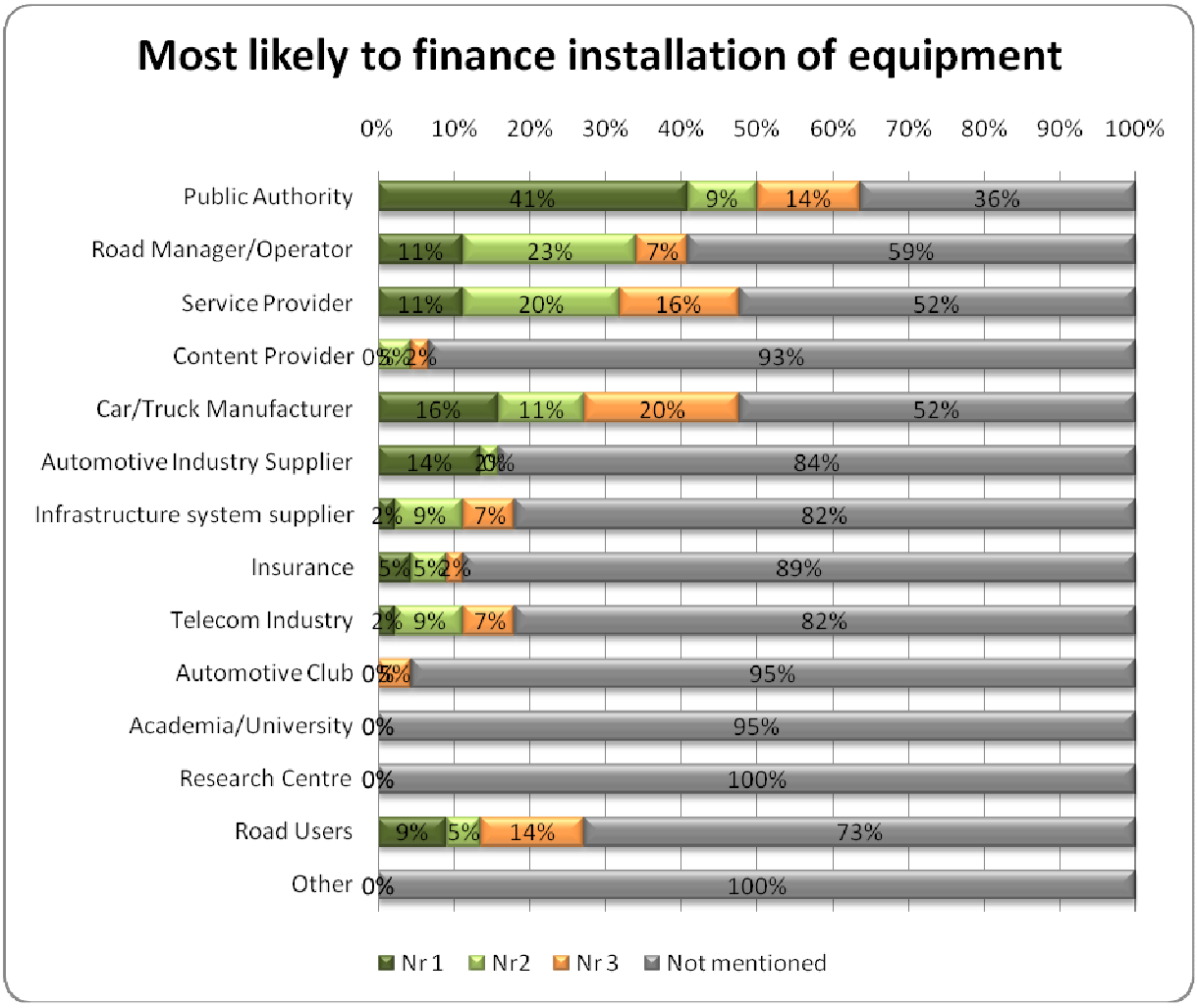
In general respondents are positive about the expected contribution of cooperative systems to a better cooperation among the road operators, as well as among road operators within one country as among organisations from different countries. A majority of 64% (=30+34) thinks it will be beneficial at the national level, while 50% (=23+27) sees advantages at the international level (see figure 7-5). Respondents comment that good cooperation among road operators within countries is simply indispensable. Only in this way cooperative systems will function well ('Without cooperation between road operators the lifetime of cooperative systems will be limited.'). Road operators should avoid 'moving one problem on one network onto another network'. 'Eventually it's the (total) network you want to manage and not just your own road'.



7-5 Contribution to better cooperation among road operators

A number of comments on the cooperation at the international level are also positive. A respondent thinks cooperative systems 'will overcome language issues and the information will be uniform to the drivers'. Another respondent considers cooperation at the international level 'essential in a global market. Systems must be interoperable across different countries for commercial long haul operators as well as personal travel if we are to reap the benefits of cooperative systems.' However, other respondents hesitate about the advantages. A respondent thinks that the improvement of the cooperation depends on the way the system will be implemented ('how seamless the services to the end user will be and roles of the different road operator'). Others think that there is a contribution to better international cooperation, 'but not in the first phase' or not a substantial one ('there's not much space left to win.').

The initial deployment of cooperative systems will require significant investments. Most of the respondents see an important role for the public authority in this. Totally 64% of the respondents rank the public authority among the first three stakeholders regarding the investments; 41% sees it as the most important, while 9 and 14% rank the authority at a second and third place respectively (see figure 7-6). Other important stakeholders mentioned in this respect are car manufactures (ranked among the first three stakeholders by 16+11+20=47%), service providers (11+20+16=47%) and road operators (11+23+7=41%).



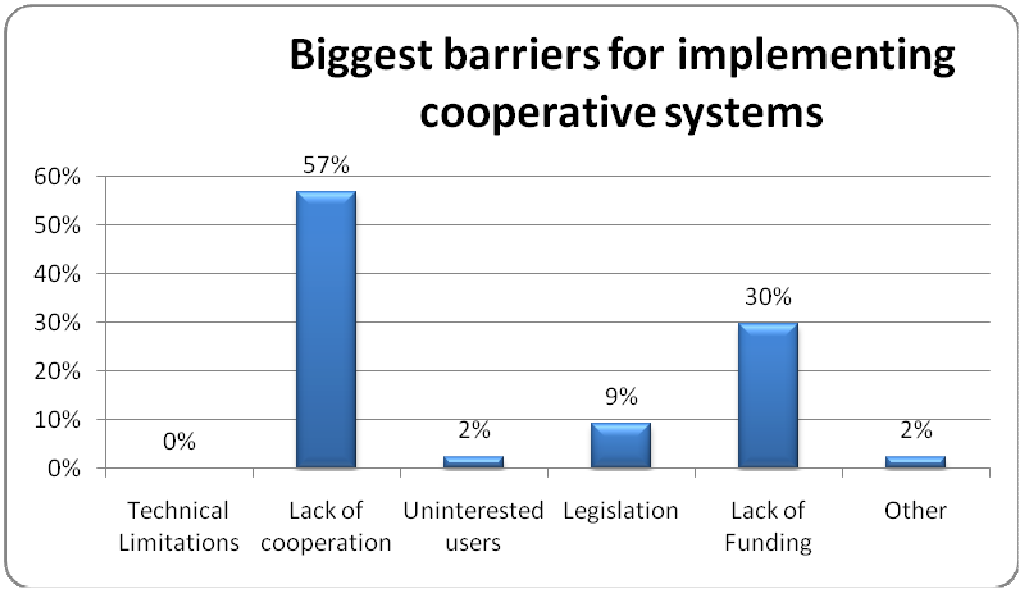
7-6 Stakeholders most likely to invest in the initial deployment of cooperative systems

7.3. Perceived barriers and Instruments to promote cooperative systems

The majority of the respondents (57%) considers a lack of cooperation among stakeholders as the biggest barrier for the implementation of cooperative systems (see figure 7-7). About one-third (30%) mentions the lack of funding as the most important and 9% legislation. Only 2% thinks 'uninterested users' are the most important and 2% sees other important barriers ('Agreeing the benefits to investors... it has not been easy to quantify any significant benefits with confidence').

In order to promote cooperative systems, many respondents think it is important to install these systems in cars as standard equipment (instead of optional). Totally 65% of the respondents rank this measure among the first three instruments that could be useful to promote the further development and future use of the systems. About a quarter (27%) sees it as the most important measure, while 20 and 18% rank it at a second and third place

respectively (see figure 7-8). Other important instruments are field operational tests and cooperative research, selected by totally 48 and 41% as one of the three most important instruments. About one third of the respondents selected the instruments 'voluntary agreement' and 'legislative mandatory equipment' and about a quarter of the respondents the instruments 'awareness campaigns', 'advertising media' and 'driver education – driver training'.



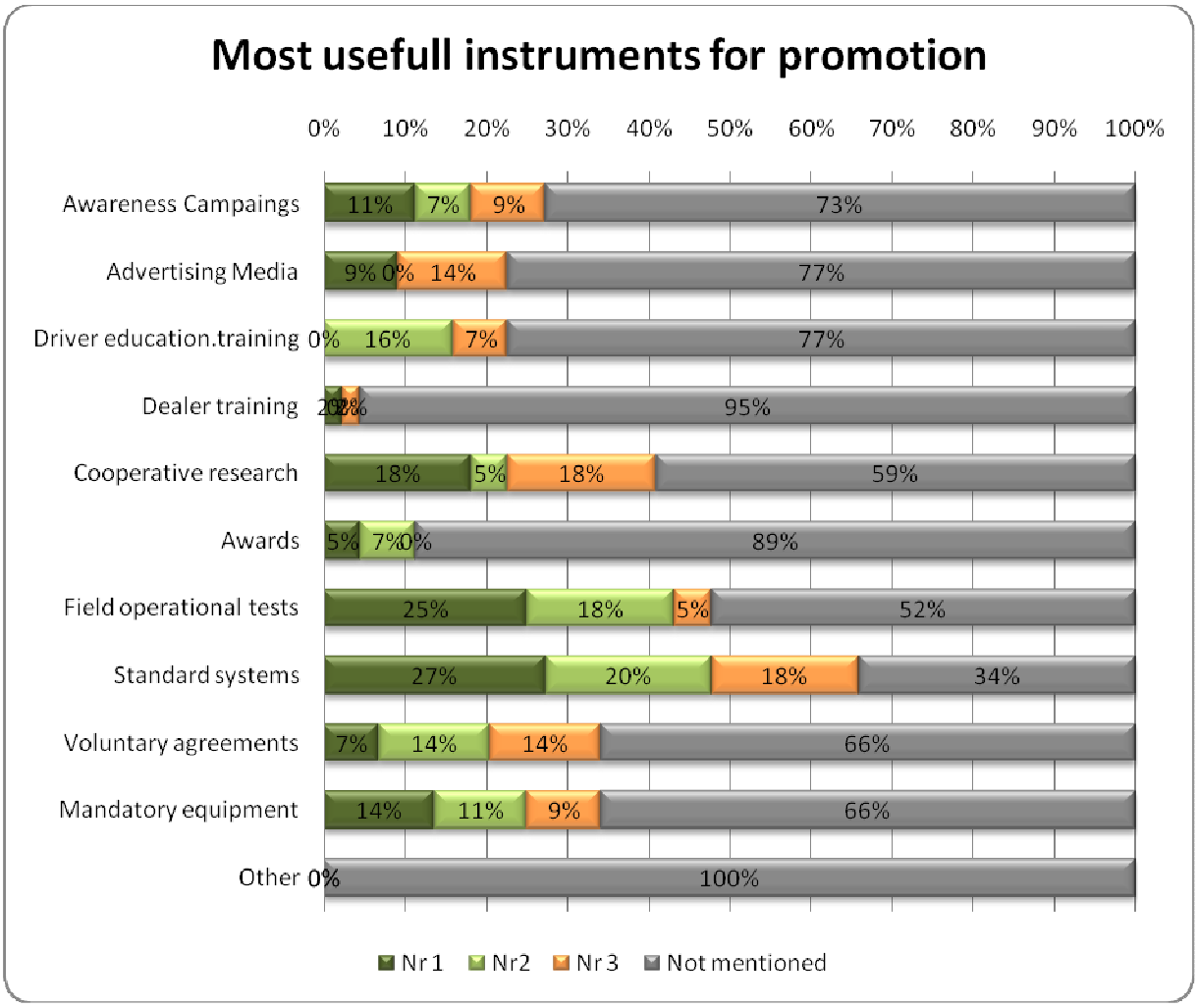
7-7 Biggest barriers for implementing cooperative systems

The respondents consider four financial instruments as the most important in order to promote cooperative systems: tax reduction, market package (car plus starting insurance formula), insurance reduction and direct subsidies. About 60% of the respondents rank these four instruments among the three most effective (see figure 7-9). About one third of the respondents selected the instrument 'discount'. Other instruments mentioned by the respondents are: financing the provision of data (so that they are 'free accessible') and financing equipment so that it can be introduced as standard.

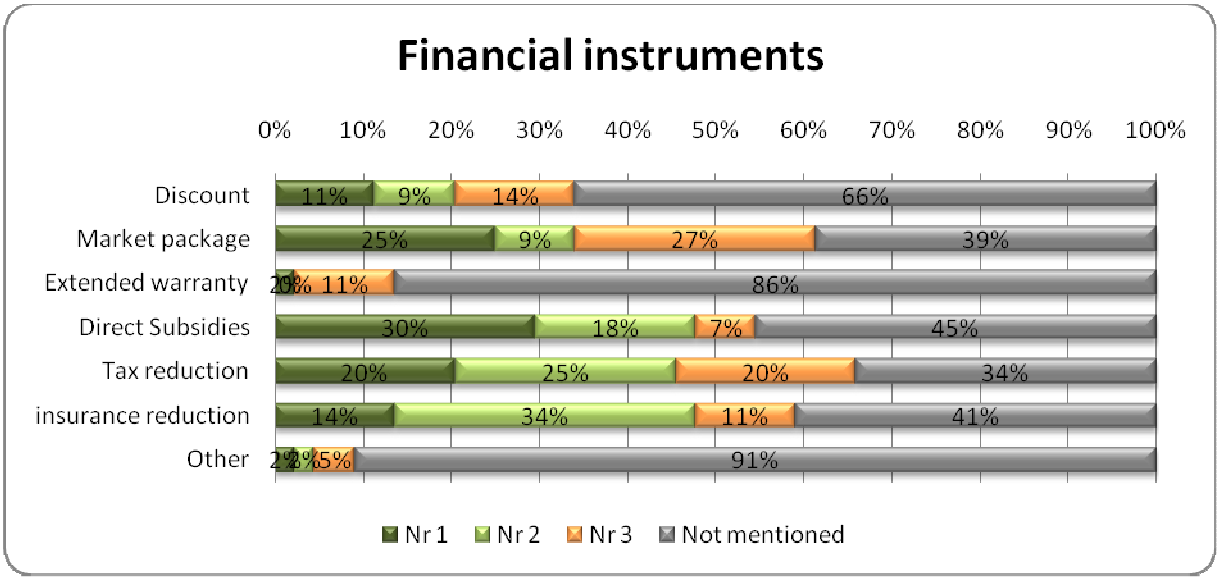
7.4. Other systems

Keeping in mind the context of the deployment of European cooperative systems, other systems that have much ground in common may be relevant. Therefore, in the questionnaire attention was paid to systems with similar purposes and to relations with systems for road charging.

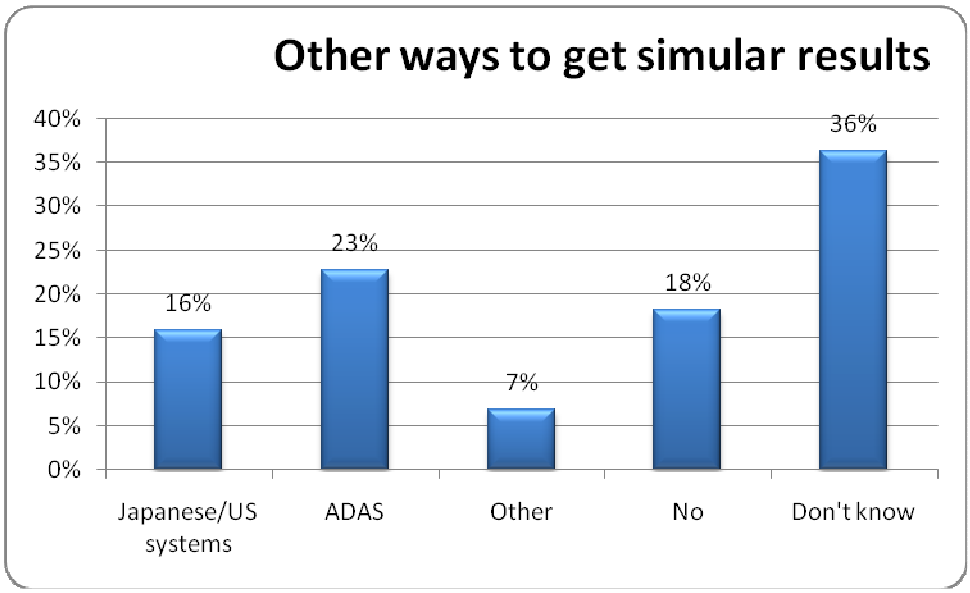
Concerning systems with similar purposes, less than half of the respondents (46%) think that other systems can lead to similar results as European cooperative systems. About a quarter of all respondents (23%) mentions ADAS (Advanced Driver Assistance System) as an alternative; 16% mentions systems from Japan or the US and 7% other systems. A relatively big percentage (36%) of the respondents state that they do not know, whether similar results can be obtained in another way, while 18% answers 'No' (see figure7-10).



7-8 Most usefull instruments to promote cooperative systems

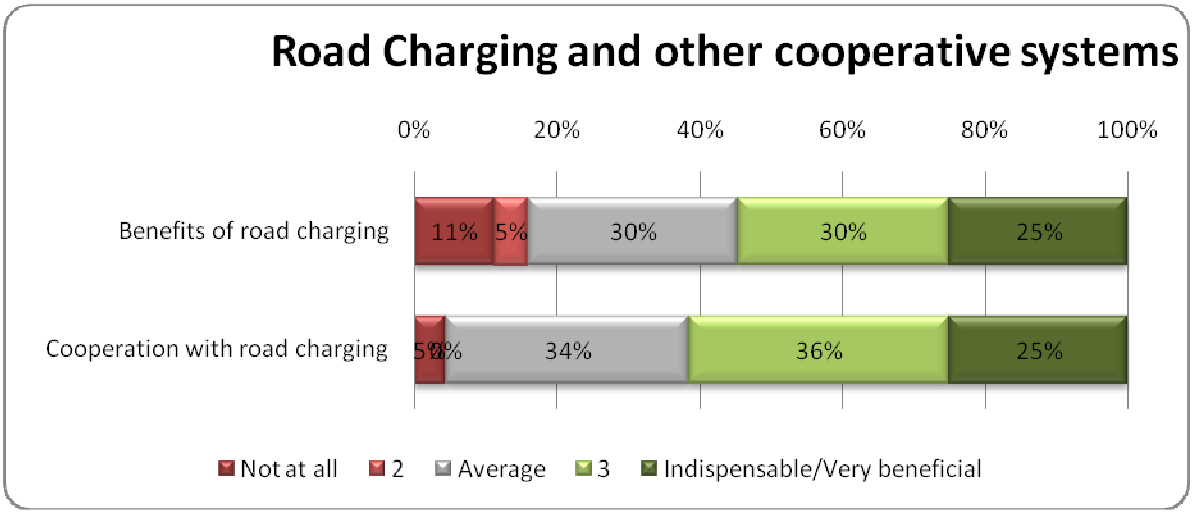


7-9 Financial instruments to promote cooperative systems



7-10 ***Alternatives for European cooperative systems***

In a number of countries, road charging is already in place or implementation is being discussed. Increasingly stakeholders are looking at in-car systems as part of road charging implementations. A majority of the respondents (30+25=55%) considers this development as beneficial for the deployment of (other) cooperative applications (figure 7-11). A number of respondents comments, that 'if the car has some kind of device on board, it is easy to widen the capabilities of the device'. Moreover, respondents see advantages regarding drivers getting used to additional equipment in-car ('learning, experiencing'). On the other hand a number of respondents would like to see the deployment separately in order to avoid becoming subject of too many political discussions. Road charging 'is not a good example for CVIS!'. 'The standardization discussion is still raging on.



7-11 Road Charging and other cooperative systems

A majority (36+25=61%) of the respondents think that there should be cooperation in the deployment of road charging and (other) cooperative systems. Respondents mention advantages when the same infrastructure can be used (less costs) and similar 'public/social benefits'. There is 'great benefit from having a carrot as well as a stick to promote safe, efficient and enjoyable driving'. On the other hand a number of respondents think cooperation is not useful because of too big differences. 'There will be different organizations with different missions, goals and targets. Not very useful to combine these, they differ too much.'

7.5. Résumé

- All respondents think that the number of cars equipped with cooperative devices will increase. The respondents expect that in 2030 more than half of the vehicles have most of the nine applications presented. The respondents expect the biggest growth for the application In-vehicle updates.
- More than half of the respondents think that road operators should play an important role in implementing and using cooperative applications. However, the respondents think that the role of car manufacturers, the government and service providers is even more important.
- Almost all respondents consider cooperation among stakeholders important or even indispensable for the deployment of cooperative systems. A majority of the respondents think that the lack of cooperation is the biggest barrier for implementing cooperative systems (more important than the lack of funding).
- A majority of the respondents think the public authority has the most important role regarding the initial investments in cooperative systems. Other important investors mentioned are car manufactures, service providers and road operators.
- The respondents consider installing systems in cars as standard equipment (instead of optional) as the most useful instrument to promote cooperative systems. Other important instruments are field operational tests and cooperative research.
- The respondents see tax reduction, market package (car plus starting insurance formula), insurance reduction and direct subsidies as the most important financial instruments.
- A majority of the respondents considers the development of systems for road charging beneficial for the deployment of (other) cooperative systems and thinks that there should be cooperation in the deployment of the systems.

Literature

1. CVIS DEPN 4.1a User Survey, RACC Automobile Club, 9 April 2008.
2. Michele Francano, Questionnaire for the manufacturers consultation, Centro Ricerche Fiat, Orbassano (TO), 1 July 2008.
3. Damaris Omasits and Peter Saleh , CVIS DEPN Topic 4: Scenario for the Road Operator, FEHRL (Arsenal Research), 16 June 2008.

Annex A, Questionnaire

Introduction

This questionnaire is about the introduction of cooperative systems[3] in transport. By means of this questionnaire a team of the European project CVIS[4] seeks the opinion of road operators[5] about such systems.

The CVIS-team would appreciate your cooperation very much. Please note that the questionnaire[6] is anonymous. All the information that you provide is absolutely confidential. It will be used for analysis purposes only and will not be traceable to a single person.

Please return the questionnaire by January 1, 2009

The CVIS-team thanks you in advance for taking the time to respond!

For more background information, please click:

- cooperative systems[3];
- CVIS[4];
- survey for road operators[5] or
- questionnaire[6].

Or look at the website: http://www.cvisproject.org/

Cooperative Systems

The mobility of people and goods generates high societal costs in terms of traffic congestion, pollution, noise, fatalities and injuries. New technologies may contribute to reducing these negative effects. E.g. road safety can benefit from the development of driver assistance applications which use sensor technologies to perceive the traffic situation around the vehicle and, in case of danger, warn the driver.

Intelligent cooperative systems based on vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communications hold the promise of great improvements both in the efficiency of the transport systems and in the safety of all road users. These systems will allow vehicles to cooperate directly with nearby vehicles, with the immediate roadside infrastructure, and with the traffic management control centre, sharing information on the latest traffic information for greater safety, efficiency and a better environment. Each equipped vehicle will be able to connect and communicate via local ad-hoc networks of vehicles and roadside equipment in the vicinity, and also via an always-on network connection to access a wide range of travel support and other services.

CVIS

CVIS (Cooperative Vehicle-Infrastructure Systems) is a research project co-funded by the European Commission, developing functions to be installed on vehicles and also on the road infrastructure. In short, the CVIS objectives are:

- to create a unified technical solution allowing all vehicles and infrastructure elements to communicate with each other;

[3] Link to paragraph “Cooperative Systems”

[4] Link to paragraph “CVIS”

[5] Link to paragraph “Utility Survey Road Operator”

[6] Link to paragraph “Questionnaire”

- to enable a wide range of potential cooperative services;
- to define and validate an open architecture and system concept for a number of cooperative system applications;
- to address issues such as user acceptance, data privacy, interoperability, risk and liability, public policy needs, cost/benefit and business models, and roll-out plans for implementation.

Utility Survey Road Operator

The business model for cooperative systems is a complex issue. Many parties are involved and there are still many questions to be answered. In the CVIS project there is a team focusing on a deployment plan, addressing risks, mitigation strategies, legal aspects, business and user acceptance aspects. One of the tasks of this team is to conduct a utility analysis for each principal stakeholder for cooperative systems.
Road operators/administrators are very important stakeholders. What do they think about cooperative systems, applications and services? What are the main arguments in favour or against? Would road operators be willing to invest in such developments? And which strategies would be preferred for implementation?

Questionnaire

This survey is a quick exercise to investigate the relevant aspects from the road operator point of view. The CVIS-project members have reached a certain level of understanding, but the expert vision of the road operator is needed to extract useful elements for the future deployment of cooperative systems. Therefore the CVIS-team would like to ask your help by responding to the questions. Please note that there are no right or wrong answers. It is the opinion of the professionals working as road operators that counts. Moreover this questionnaire is a chance for you to have an impact on the development of cooperative systems!

Topics

In this section, we present four topics that we think are relevant to road operators:

- traffic management;
- congestion management;
- road safety and
- road maintenance.

2.0 How important are these topics to your organization?

Please rank the topics by allocating a number (1, 2, 3, etc.; 1=most important).

Traffic management

Congestion management

Road safety

Road maintenance

Other, please specify

For each topic, we would like you to answer a number of questions.

2.1 Traffic Management

2.1.1 Currently, does your organization use any intelligent / cooperative systems for traffic management?

☐ Yes, please select:

- ☐ Signal control (fixed time)
- ☐ Signal control (dynamic optimisation)
- ☐ Real time incident detection
- ☐ Variable message signs
- ☐ Real time information via website
- ☐ Real time information via terminals/kiosks
- ☐ Highway Advisory Radio
- ☐ Route Guidance/Navigation
- ☐ Speed enforcement cameras
- ☐ Variable Speed limit
- ☐ Lane control signals
- ☐ Public Transport Priority/Selective vehicle detection
- ☐ Weigh in motion (a technique to measure the axle loads of moving trucks)
- ☐ Other, please specify:

☐ No

☐ I don't know

2.1.2 Do you, as a road operator, think cooperative systems can have an important role in traffic management?

Please click one answer on a five point scale (most left="No, not important at all")

No, not important at all O O O O O Yes, they are indispensable

2.1.3 Do you, as a road operator, think floating car data[7] collection would be beneficial for traffic management?

No, not beneficial at all O O O O O Yes, it is indispensable

2.1.4 Are you, as a road operator, willing to invest in cooperative systems for traffic management?

Not at all O O O O O Yes, certainly

2.2 Congestion management

2.2.1 Currently, does your organization use any intelligent / cooperative systems for congestion management?

☐ Yes, please select:

- ☐ Signal control (fixed time)
- ☐ Signal control (dynamic optimisation)
- ☐ Real time incident detection
- ☐ Variable message signs
- ☐ Real time information via website
- ☐ Real time information via terminals/kiosks
- ☐ Highway Advisory Radio
- ☐ Route Guidance/Navigation
- ☐ Speed enforcement cameras
- ☐ Variable Speed limit
- ☐ Lane control signals
- ☐ Public Transport Priority/Selective vehicle detection
- ☐ Weigh in motion
- ☐ Other, please specify:

☐ No

☐ I don't know

2.2.2 Do you think cooperative systems can have an important role in congestion management?

No, not important at all O O O O O Yes, they are indispensable

2.2.3 Do you, as a road operator, think floating car data collection would be beneficial for congestion management?

No, not beneficial at all O O O O O Yes, it is indispensable

2.2.5 Are you, as a road operator, willing to invest in cooperative systems for congestion management?

Not at all O O O O O Yes, certainly

2.3 Road Safety

2.3.1 Currently, does your organization use any intelligent / cooperative systems for road safety?

[7] Link to a definition/explanation.
Floating car data is the collection of various types of data from driving vehicles, e.g. speed, location and road surface conditions.

☐ Yes, please select:

- ☐ Signal control (fixed time)
- ☐ Signal control (dynamic optimisation)
- ☐ Real time incident detection
- ☐ Variable message signs
- ☐ Real time information via website
- ☐ Real time information via terminals/kiosks
- ☐ Highway Advisory Radio
- ☐ Route Guidance/Navigation
- ☐ Speed enforcement cameras
- ☐ Variable Speed limit
- ☐ Lane control signals
- ☐ Public Transport Priority/Selective vehicle detection
- ☐ Weigh in motion
- ☐ Other, please specify:

☐ No

☐ I don't know

2.3.2 Do you think cooperative systems can have an important role in road safety?

No, not important at all O O O O O Yes, they are indispensable

2.3.3 Do you, as a road operator, think floating car data collection would be beneficial for road safety?

No, not beneficial at all O O O O O Yes, it is indispensable

2.3.4 Are you, as a road operator, willing to invest in cooperative systems for road safety?

Not at all O O O O O Yes, certainly

2.4 Road Maintenance

2.4.1 Currently, does your organization use any intelligent / cooperative systems for road maintenance?

☐ Yes, please select:

- ☐ Signal control (fixed time)
- ☐ Signal control (dynamic optimisation)
- ☐ Real time incident detection
- ☐ Variable message signs
- ☐ Real time information via website
- ☐ Real time information via terminals/kiosks
- ☐ Highway Advisory Radio
- ☐ Route Guidance/Navigation
- ☐ Speed enforcement cameras
- ☐ Variable Speed limit
- ☐ Lane control signals
- ☐ Public Transport Priority/Selective vehicle detection
- ☐ Weigh in motion
- ☐ Other, please specify:

☐ No

☐ I don't know

2.4.2 Do you think cooperative systems can have an important role in road maintenance?

No, not important at all O O O O O Yes, they are indispensable

2.4.3 Do you, as a road operator, think floating car data collection would be beneficial for road maintenance?

No, not beneficial at all O O O O O Yes, it is indispensable

2.4.4 Are you, as a road operator, willing to invest in cooperative systems for road maintenance?

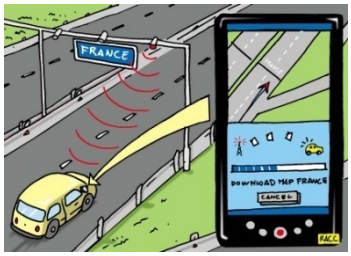
Not at all O O O O O Yes, certainly

CVIS Applications

In this section, you find a description of CVIS applications. These are examples of the types of applications that are developed within the CVIS project. Please answer the questions for each of these applications.

1	In-Vehicle Map updates

Cars have navigation systems and they can receive map updates (e.g. when crossing the border to another country), real time traffic information or road infrastructure status data.



3.1.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.1.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.1.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

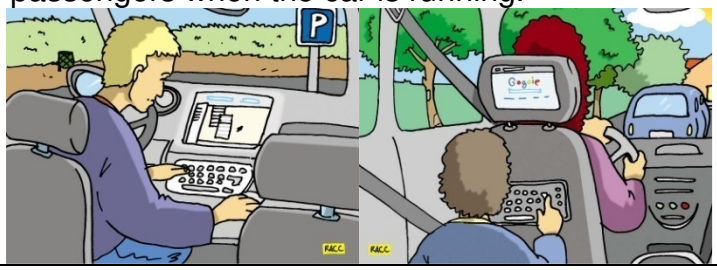
Not at all O O O O O Yes, certainly

Please explain your answer:

3.1.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

2	In-Vehicle Internet / Mobile Office

Provision of in car internet services that can be used by the driver when the car is stopped or by the passengers when the car is running.



3.2.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.2.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.2.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

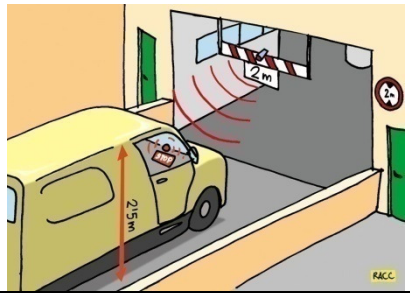
Not at all O O O O O Yes, certainly

Please explain your answer:

3.2.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etcetera)

3	Obstacle Warning

Drivers receive real-time information from roadside sensors or other vehicles, e.g. a warning that the vehicle is too tall (tunnel, parking).



3.3.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.3.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.3.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

Not at all O O O O O Yes, certainly

Please explain your answer:

3.3.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

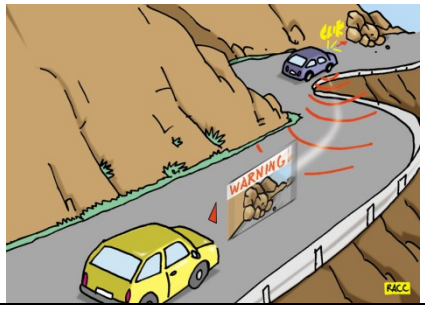
3.3.5 Do you think it is specifically beneficial that drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

4	Road Status Report

Cars send/receive useful information to/from other vehicles about road conditions (e.g. slippery road surface or obstacles).



3.4.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.4.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.4.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

Not at all O O O O O Yes, certainly

Please explain your answer:

3.4.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etcetera)

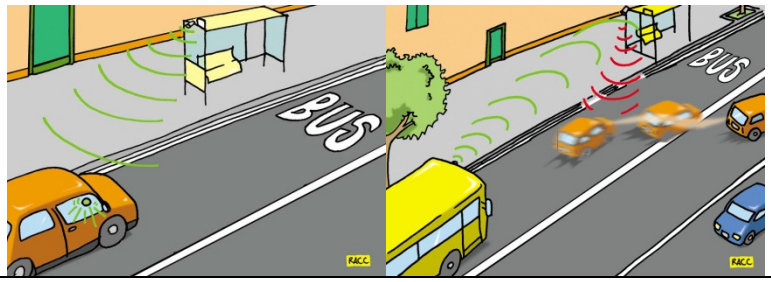
3.4.5 Do you think it is specifically beneficial if drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

5	Flexible Lane Allocation

Cars receive information about the availability of bus lanes. In this way it will be possible to increase the capacity on certain road sections of the urban network by providing the use of bus lanes to selected other vehicles, without causing disturbances to the public transport.



3.5.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.5.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.5.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

Not at all O O O O O Yes, certainly

Please explain your answer:

3.5.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

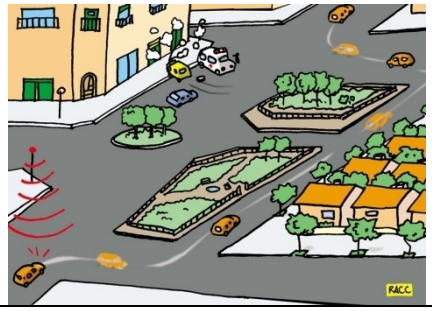
3.5.5 Do you think it is specifically beneficial if drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

6	Area Routing and Control

Road users are offered alternative routes for urban areas in case of incidents/traffic jams.



3.6.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.6.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.6.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment? (financial or societal benefits)

Not at all O O O O O Yes, certainly

Please explain your answer:

3.6.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

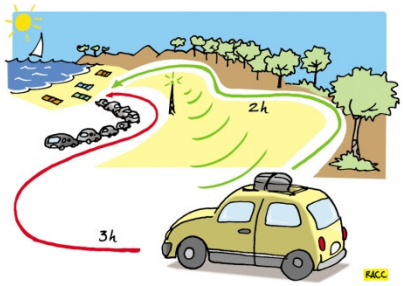
3.6.5 Do you think it is specifically beneficial if drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

7	Cooperative Traveller Assistance (CTA)

The goal of CTA is to give support to drivers to plan trips beforehand and while travelling by providing travel updates (e.g. traffic situation, incidents and crowdedness at the destination).



3.7.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.7.2 Do you think this application is useful to road system operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.7.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.7.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

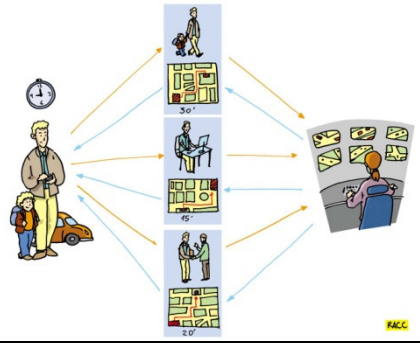
3.7.5 Do you think it is specifically beneficial if drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

8	Personalized route planning based on expected travel times

Users can register their daily activities and preferences. The application provides users a personalized route planning. The information could help traffic managers to predict traffic perturbations and manage the traffic.



3.8.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.8.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.8.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.8.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etc.)

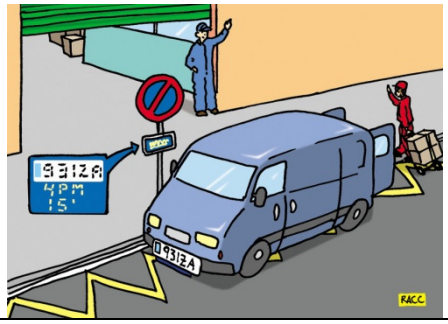
3.8.5 Do you think it is specifically beneficial if drivers get information in car (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

9	Urban Parking zones

This application enables booking of urban parking space in advance (for commercial and other vehicles).



3.9.1 Do you think this application will benefit road traffic?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.9.2 Do you think this application is useful to road operators?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.9.3 Would you, as a road operator, be willing to invest in this application? Do you think you can get a good return on investment?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.9.4 From your current knowledge, what specific requirements do you have for this application as a road operator?
(looking at road safety, the tasks of a road operator, the role of the road user, etcetera)

3.9.5 Do you think it is specifically beneficial if drivers get information <u>in car</u> (instead of e.g. from signs along the road)?

Not at all O O O O O Yes, certainly

Please explain your answer:

3.10 If you had to invest in these applications, which one would you select?

Please rank the topics by allocating a number (1, 2, 3, etc.; 1=most likely).

1. In-Vehicle Map updates	
2. In-Vehicle Internet / Mobile Office	
3. Obstacle Warning	
4. Road Status Report	
5. Flexible Lane Allocation	
6. Area Routing and Control	
7. Cooperative Traveler Assistance (CTA)	
8. Personalised route planning based on expected travel times	
9. Urban Parking zones	

3.11 Do you think one or more of these applications can replace existing systems that your organisation is using at the moment? Would you consider using this/these application(s)?

☐ Yes

☐ No

Please specify the applications:

3.12 This questionnaire focuses on a number of example applications that are being developed within the CVIS project. Apart from these applications, what other kinds of applications could be useful for road operators?

Deployment

This section addresses the deployment of applications. Please answer the questions below.

4.1 How do you, as a road operator, see your role in implementing and using cooperative applications in transport?

No role at all O O O O O Leading

4.2 How do you, as a road operator, see the role of other groups in implementing and using these applications?

Government No role at all O O O O O Leading

Car manufacturers No role at all O O O O O Leading

Service Providers No role at all O O O O O Leading

Road users No role at all O O O O O Leading

other stakeholder, please specify:

No role at all O O O O O Leading

Please explain your answer:

4.3 How important is, in your opinion, cooperation between stakeholders in the field of cooperative applications?

Not important at all O O O O O Yes, this is indispensable

Please explain your answer:

4.4 The initial deployment will require significant investments. In your opinion, who is most likely to finance the installation of the equipment necessary for the realization of cooperative applications?

Please select three stakeholders by allocating a number (1, 2 and 3, 1=most likely)

Public Authority

Road Manager/Operator

Service Provider

Content Provider

Car/Truck Manufacturer

Automotive Industry Supplier

Infrastructure System Supplier

Insurance

Telecommunication Industry

Automotive Club

Academia/University

Research Centre

Road users

Other, please specify:

4.5 Do you think, there is another way to reach similar results to those that the development of European cooperative systems is expected to give?

☐ Yes, by applying cooperative systems developed in Japan or the US

☐ Yes, by applying ADAS (Advanced Driver Assistance System)

☐ Yes, by applying (please specify):

☐ No

☐ I don't know

4.6 What, in your opinion, will be the biggest barrier for implementation of cooperative systems?

☐ Technical limitations

☐ Lack of cooperation among stakeholders

☐ Users are not interested

☐ Legislation

☐ Lack of funding

☐ Other, please specify:

4.7 In your opinion, which of the following instruments could be the most useful to promote the further development and future use of cooperative systems?

Please select three instruments by allocating a number (1, 2 and 3, 1=most likely)

Awareness campaigns

Advertising Media

Driver education – driver training

Dealer training

Cooperative research

Awards (e.g. Euro NCAP)

Field Operational Tests

System as standard equipment instead of optional

Voluntary agreement at European/national/company level

Legislative mandatory equipment

Other (please specify):

4.8 What percentage of vehicles in Europe do you expect to be equipped with cooperative devices in the following years? *(From 0% to 100%)*

	2015	2020	2030
1. In-Vehicle Map updates			
2. In-Vehicle Internet / Mobile Office			
3. Obstacle Warning			
4. Road Status Report			
5. Flexible Lane Allocation			
6. Area Routing and Control			
7. Cooperative Traveler Assistance (CTA)			
8. Personalised route planning based on expected travel times			
9. Urban Parking zones			

4.9 In your opinion, which of the following financial Instruments could increase the percentages that you indicated in the previous questions?

Please select three instruments by allocating a number (1, 2 and 3, 1=most likely)

Discount

Market package (car + starting insurance formula)

Extended warranty

Direct subsidies

Tax reduction

Reduction in the price of the car insurance

Other (please specify):

In a number of countries, road charging is already in place or implementation is being

discussed. Increasingly stakeholders are looking at in car systems as part of road charging implementations.

4.10 Do you think this development is beneficial for the deployment of cooperative applications?

Not beneficial at all O O O O O Yes, very beneficial

Please explain your answer:

4.11 Do you think there should be cooperation in the deployment of road charging and (other) cooperative applications?

Not necessary at all O O O O O Yes, that is indispensable

Please explain your answer:

4.12 Do you think cooperative systems will contribute to a better cooperation among road operators within one country[8]?

Not at all O O O O O Yes, certainly

Please explain your answer:

4.13 Do you think cooperative systems will contribute to a better cooperation among road operators from different countries? (cross-border)

Not at all O O O O O Yes, certainly

Please explain your answer:

[8] e.g. enabling combining traffic information from different road operators.

General questions

5.1 What kind of road operator do you represent?

☐ Public

☐ Private

☐ Public/Private

☐ Other, please specify:

5.2 What is the geographical scope of the road operator you represent?

☐ Nationwide

☐ Provincial

☐ Regional

☐ Local

☐ Other, please specify:

5.3 What is your role within the organization?

☐ Management

☐ Policy

☐ Research

☐ Advisor

☐ Operational

☐ Other, please specify:

5.4 How many years do you have experience in a road operator organization?

☐ 0-3 years

☐ 3-6 years

☐ over 6 years

5.5 How familiar do you consider yourself with Cooperative Systems related topics?

Please rate on a scale from 1 (= not familiar at all) to 10 (= highly familiar).

This survey is anonymous; the results will not be traceable to individuals. However, we would appreciate it, if you could leave your contact details so that we can contact you if answers are not entirely clear to us, and for sending you the results. The information will only be used for that purpose.

Name:

Organization:

Country:

e-mail:

Thank you for your cooperation!