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Project full title: Collaborative cApacity Programme on Its Training-educAtion and Liaison

D. 2.2

Capacity needs and knowledge gaps of ITS stakeholder groups and case studies collection

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Abstract

The aim of CAPITAL is to build a collaborative capacity community and deployment programme to support public and private stakeholders in the implementation of (C-)ITS with training and educational resources. Developing suitable training programmes that tackle the real capacity needs and identification of needs of the main stakeholder groups and their knowledge gaps are crucial issues within the CAPITAL project activities. Task 2.2. focused specifically on this issue and used a variety of instruments (e.g. web-based questionnaire, interviews, self-assessment, etc.) to collect data on the needs on the main target groups for training (“trainees”) within CAPITAL which will be predominantly public authorities. For the analysis of the existing knowledge gaps and stakeholders’ training needs, different analysis procedures were selected according to the different type of data received, using as well quantitative statistical methods like chi-square test of independence for the answers received by the online questionnaire, as the qualitative content analysis (QCA) for the qualitative interviews and the self-assessment. The results of the different data sources were analysed separately in a first step and then compared to each other in the areas of “priority topics”, “barriers and challenges for ITS implementation”, “main interests for training” and “preferred types of trainings”.

The analysis revealed the fact that different topics for different know-how levels will be needed. The priority topics were identified for each of the know-how levels. The sharing of best-practice cases and training on evaluation methods and cost-benefit analysis of ITS services are the main areas of interest. CAPITAL should develop a training programme combining easy to access and flexible online training possibilities (including online courses and webinars) and face-to-face training possibilities (such as workshops and on-site visits). Personal contact with and between participants, a network of trust, specific focus on local activities and a very practical training will be needed. Besides the concrete training activities within CAPITAL, there is also a need for activities outside the training programme that will foster further cooperation in the complex multi-stakeholder environment in the ITS sector and awareness of benefits of ITS in general.

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### Abbreviations and Acronyms

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<tr>
<td>CEF</td>
<td>Connecting Europe Facility (EU funding instrument)</td>
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<td>C-ITS</td>
<td>Cooperative Intelligent Transport Systems</td>
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<tr>
<td>DSTC</td>
<td>Dynamic Stability and Traction Control</td>
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<tr>
<td>EC</td>
<td>European Commission</td>
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<td>ESC</td>
<td>Electronic Stability Control</td>
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<td>EU</td>
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<td>GA</td>
<td>Grant Agreement</td>
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<td>GLOSA</td>
<td>Green Light Optimal Speed Advisory</td>
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<td>ITS</td>
<td>Intelligent Transport Systems</td>
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<tr>
<td>OBU</td>
<td>On Board Unit</td>
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<tr>
<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<td>PO</td>
<td>Project officer</td>
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<tr>
<td>QCA</td>
<td>Qualitative Content Analysis</td>
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<td>RSU</td>
<td>Road Side Unit</td>
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<td>TLV</td>
<td>Traffic Light Control</td>
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<td>TSC</td>
<td>Traction Control System</td>
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<td>VSC</td>
<td>Vehicle Skid Control</td>
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<td>WP</td>
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Executive Summary

The aim of CAPITAL is to build a collaborative capacity community and deployment programme to support public and private stakeholders in the implementation of (C-)ITS with training and educational resources. Developing suitable training programmes that tackle the real capacity needs and identification of the needs of the main stakeholder groups and their know-how gaps are a crucial issue within the CAPITAL project activities. Task 2.2. focused specifically on this issue and used a variety of instruments (e.g. web-based questionnaire, interviews, self-assessment, etc.) to collect data on the needs on the main target groups for training (“trainees”) within CAPITAL which will be predominantly public authorities (including national authorities, local and regional authorities like cities, provinces, regions, transport authorities, road administrations) followed by transport operators (e.g. road operators, public transport operators) and fleet owners (for passengers and freight). The target groups of suppliers (which can be public as well as private and include technology suppliers, industry platforms, data and transport service related providers) and the group of knowledge providers will be involved for exchange and knowledge transfer between the groups, but will not be trained themselves in the framework of CAPITAL. Furthermore, the needs professional end-users or more specific professional drivers (which are the “end-users” that can be reached by the platform like truck drivers) will be tackled within the project. As their needs are very specific, only the assessment will be done within CAPITAL and will be transferred into a specific training programme for professional end-users. The training itself will be combined with the activities of the IRU academy in order to ensure that the target group can be reached in an appropriate way. Therefore, no specific training programme for professional end-users is planned within CAPITAL and the needs of this target group are not further considered for the conclusions and recommendations for the training programme.

The data collection process for the needs assessment of the main target groups of CAPITAL was performed in several steps, using different inputs and data sources. Based on that, different (qualitative and quantitative) methods were selected according to their suitability to the available data and applied. The underlying goal was to collect answers on the one hand from different EU Member States to guarantee the geographical coverage and from the different CAPITAL stakeholder groups to be able to address the different training needs. Furthermore, three different levels of know-how were defined in order to differentiate between the different know-how levels. Respondents of the web-based questionnaire were asked to self-assess their know-how level. Therefore, the results were also analysed based on this distinction on the level of ITS know-how as it is:

- **1st Level - ITS start-up communities with no or very limited know-how on the deployment of ITS.**
- **2nd Level - advanced and intermediary communities that already gained some experience or familiarity with different ITS systems or already deployed ITS applications/services in their sphere of influence.**
- **3rd Level - highly experienced communities that have extensive experience in research and deployment of ITS technologies.**
Having the different goals in mind, it can be concluded that the main target group (public authorities) was reached appropriately, also including the different regional levels the public authorities are working at (local authorities like cities, regional authorities, national authorities or international authorities), as well as all know-how levels (1st, 2nd and 3rd level). Furthermore, a wide variety of 23 different countries could be reached. In total, 117 completed web-based questionnaires were included in the statistical analysis. A substantial amount of responses was received from Great Britain, Greece, Finland, the Netherlands, Austria and Italy, and this has to be considered when interpreting the results. Nevertheless, several EU countries from different parts of Europe were represented in the data set. This allowed derivation of recommendations applicable to EU countries with certain level of caution.

In addition, 9 interviews were carried out covering different know-how levels from the main target group of public authorities (two with 3rd level cities, one 2nd level city and one 1st level city), one fleet owner and one data service provider and three interviews with different research institutions from different countries. The self-assessment of the consortium was provided by 9 CAPITAL partners. In addition the content and discussion of a specific Special Interest Session on “(C-)ITS for public authorities: challenges and barriers to deployment – from West to East” was summarized as supplemental input for the further needs assessment. The session which took place during the ITS Europe Congress in Strasbourg on the 21 June 2017 was specifically organised to collect information on the needs and views of the public authorities from different backgrounds and to reveal existing challenges in the deployment of C-ITS and the related needs for training.

For the analysis of the existing knowledge gaps and the training needs different analysis procedures were selected. According to the different type of collected data quantitative statistical analysis methods like chi-square test of independence were applied for the answers received by the online questionnaire, as well as qualitative content analysis (QCA) for the qualitative interviews and the self-assessment as a systematic and rule guided approach to analyse texts per analysing categories. This approach combines qualitative methods and quantitative logic and is suitable for a mixed methods analysis, like provided in this deliverable. The results of the different data sources were analysed separately in a first step and then compared to each other. In this respect, it has to be considered that only the results of the web-based questionnaire have statistical significance and are therefore the core results of the analysis. The analysis of information from additional sources such as interviews, self-assessment, etc. was carried out to deepen the understanding of the results and to cross-check the results received. For all data sources, priority topics, barriers and challenges for ITS deployment, main interests for training and preferred training tools, or to be more specific different types for training, were analysed. Finally, conclusions were derived and recommendations were formulated for the CAPITAL training programme.

The analysis and comparison of the input data showed that the main priority topics are “Access and Management of Data”, “C-ITS”, “Passenger Transport Services”, “Traffic Management and Network Control” and “Traveller Information Services” on a meta level. As the assessment of priority topics was done on a subtopic level, these main topics could be specified more in detail for the training programme. The statistical analysis of the association between the different background variables (organisation type, regional level, know-how level) and the priority subtopics showed that there was
a statistically significant difference in the relevance of the priority subtopics between the different ITS know-how levels. This means that training programmes need to target the different know-how levels with specific subtopics. According to the results of the study, training programmes for ITS starters (1st level) should focus on: “Traffic control in urban areas”, “Access to dynamic transport data”, “Integrated Traffic Management” and “C-ITS in urban areas”. Training measures for 2nd level ITS practitioners should focus on “Event Detection and Transport Data Collection”, “Safety and Security for Passenger Transport” and “Multimodal Journey Planning”. Training courses for 3rd level ITS experts should cover also the topic “Event Detection and Transport Data Collection”, as well as “C-ITS on high level road network”, “Aggregation and Management of Transport Data” or “Access to Dynamic Transport Data”.

Besides the main priority topics, the main interest for training could be identified as sharing of best-practice cases and training on evaluation methods and cost-benefit analysis of ITS services. Furthermore, specific training measures dealing with procurement issues for innovative solutions and business-models for ITS services should be provided. The business models collected and analysed in task 2.3. and described in chapter 3 will build an important basis for this. Training measures for public authorities should also cover the topic of “Financing and Funding ITS implementation”. The developed training programme should combine easy to access and flexible online training possibilities (including online courses and webinars) and face-to-face training possibilities (as workshops and on-site visits) to ensure personal contact with the trainers and other trainees, to allow exchange of information and experience with others with the same background and the same problems and to build up a network that ensures further mutual learning and cooperation. These possibilities for personal exchange of information and experience should take place on local level and focus on the specific needs and challenges of the locals and should be very practical. The peer-to-peer training concept combined with the principle of know-how transfer and exchange between different groups as suggested by CAPITAL will be followed, having in mind that “motivation” of the “right” trainers will be a crucial issue. Furthermore, the training programmes will be a good opportunity to build networks of trust, which are the basis for further cooperation and collaboration in the ITS sector as the lacking cooperation and coordination in the multi-stakeholder environment is one of the most important barriers for the implementation of ITS and should be tackled by specific activities. Training activities can support this by preparing ITS starters to deal with this challenge on the one hand and by organising dedicated activities that foster further cooperation and coordination.

There is not only a need for training within CAPITAL, but also for activities to support the implementation of ITS beyond these specific training courses: There is a need for raising more awareness for the benefits and costs of ITS also outside the CAPITAL training programme.
1. Introduction

1.1. Purpose and structure of this document

The main purpose of this deliverable is to report on the identified needs and requirements for establishing the collaborative capacity building programme within CAPITAL and provide recommendations for the further elaboration of the programme. In addition, this deliverable provides a set of case studies and business models that will feed into the transferability handbook and the analysis in WP3.

In summary, this deliverable combines the activities and outcomes of two different tasks:
- the results of task 2.2 with the aim of identifying needs and requirements for establishing a collaborative capacity building of ITS communities
- the results of task 2.3. including a set of case studies and business models that will feed task 2.4. and WP3.

Considering this the deliverable is structured in the following way:
- Chapter 2 will focus on the results of task 2.2. and will provide the analysis of the capacity needs and knowledge gaps. Within this chapter the methods and procedures for obtaining these needs are described. Based on that the results and the analysis of the data are presented. The chapter is concluded by a separate summary of results and main conclusions from these activities.
- Chapter 3 will focus on the activities and outcomes of task 3.2. including assessment of business models and related case studies. In line with the structure of chapter 2 the collection and selection of the business models is described, followed by the analysis of the selected case studies and the assessment of the business models. The outcome is summarised by mapping the business models. Finally, the chapter presented conclusions related to analysed case studies and business models.
- Chapter 4 is focused on the recommendations for building this collaborative capacity building programme. Based on the conclusions and outcomes of the previous chapters a number of measures and recommendations will be proposed on the main focus of trainings, main groups of trainees, priorities, specific training needs for the different stakeholder groups.
- Web-based questionnaire, interview guidelines and the template for self-assessment are documented in the Annex to report.

1.2. Methods used

As stated before, the methods used are described in detail in chapter 2 and chapter 3. This subchapter provides a short overview on the main input sources and the methods the consortium decided to use for each of the input data sources.
Different information sources were used for obtaining the capacity needs and identifying the knowledge gaps of the different CAPITAL trainee target groups:

- Web-based questionnaire with special focus on public authorities, transport operators, transport related service operators and ITS associations and ITS experts, with different levels of know-how
- In-depth interviews with stakeholder from the different CAPITAL stakeholder groups to deepen the understanding of the needs of different stakeholder groups and to cover target groups not already covered by the web-based questionnaire
- Self-assessment of needs within the consortium
- Discussion and inputs of public authorities on the needs and knowledge gaps within a Special Interest Session at the ITS Europe Congress in Strasbourg 2017
- Brief literature study on the needs of the professional end-users

For the web-based questionnaire, different quantitative analysis methods were applied. The results were analysed by suitable statistical methods, in this case the chi-square test of independence. In addition, case frequencies allowed making some statements on trends and priorities of the respondents, even in cases in which the sample size was too small for chi-square tests or in which the differences were not statistically significant. In-depth interviews were carried out as qualitative, partially structured interview to obtain results that would be comparable to the questionnaire. Also for the self-assessment, a structured template was provided to the consortium to ensure comparability. For the analysis of the interviews, a combination of qualitative and quantitative analysis was used. Interview transcripts and written answers to the self-assessment of needs were analysed with qualitative content analysis (QCA) which is a “systematic and rule guided approach to analyse texts per analysing categories” (Gläser and Laudel 2010).

For the outcomes of the Special Interest Session, the main discussion points were summarized and main outcomes derived in form of simple text analysis highlighting the main statements. For the needs of the professional end-users, IRU has carried out a brief literature study taking into account relevant studies on the topic.

The principles for the elaboration of the questionnaire, including the different information sources, methods, analysis methods, etc are presented as an overview in the Figure 1 (excl. the needs analysis for the professional end-users).
Figure 1: Overview of the procedures for elaborating recommendations in task 2.2.
Regarding the **collection of case studies and business models** also different data sources were used. The information was collected through focus groups, interviews, as well as by the use of the aforementioned web-based questionnaire and additional surveys. The knowledge and material available in open literature and inside the consortium was also utilized.
2. Analysis of capacity needs and knowledge gaps

2.1. Introduction, objectives and methods for data collection

As the aim of CAPITAL is to build a collaborative capacity community and deployment programme to support public and private stakeholders in the implementation of (C-)ITS (Cooperative) Intelligent Transport Systems with training and educational resources, the identification of needs and knowledge gaps of the relevant stakeholders is a crucial issue within the project activities.

The activities of WP2 of CAPITAL (Collaborative Capacity building needs and business models) focus on the identification of stakeholders relevant for CAPITAL and investigation of their needs regarding priority topics, main areas for training (e.g. cost-benefit analysis, technical requirements and standards, procurement issues, etc.) as well as preferences of training tools.

Deliverable 2.1 (Blom et.al. 2017) of CAPITAL is an important basis for this current deliverable as within that document the relevant stakeholder groups for CAPITAL were identified, a functional distinction of these groups was done and furthermore the roles of the different groups were identified and interlinked with concrete activities for engaging the different stakeholder groups. As the work performed within task 2.2 is closely linked to the decisions taken within task 2.1, the main outcomes regarding the different stakeholder groups and their roles within CAPITAL are summarized here:

In general, CAPITAL defines the following communities as its main target groups (Blom et.al. 2017, 12-13):

- **Public authorities** including national authorities, local and regional authorities (cities, provinces, regions), transport authorities, road administrations
- **Transport operators** (e.g. road operators, public transport operators) and **fleet owners** (for passengers and freight)
- **Professional end-users (professional drivers):** are the “end-users” that can be reached by the platform. Professional end-users (e.g. truck drivers) will be reached in the project. But end-users – meant as private persons and the general public – will not be in the direct focus of CAPITAL’s training activities
- **Suppliers** (can be public as well as private) include technology suppliers, industry platforms, data and transport service related providers
- **Knowledge providers** include universities and research institutions, expert groups, related platforms and associations (e.g. ITS associations, user associations), certification bodies (even if these are public authorities that act as knowledge providers in the context of the project)
- **Dissemination partners** are those stakeholders, not directly involved as trainers, trainees or content providers for the training programs, but have an important role in dissemination and awareness for the CAPITAL project and training programs.
CAPITAL defines the **roles of the different groups** as following:

Main groups for training ("trainees") within CAPITAL will be predominantly public authorities followed by transport operators and fleet owners. Suppliers and knowledge providers will be involved in information exchange and knowledge transfer between the groups, but will not be trained themselves in the framework of CAPITAL.

In general CAPITAL is based on a peer-to-peer training concept, combined with the principle of **know-how transfer and exchange between different groups**. For example, experts from the group of the public authorities will also act as trainers for other public authorities (Blom et.al. 2017, 13)

Professional end-users are a group with very specific needs. Within CAPITAL, their needs are studied as part of the activities of IRU addressed with a literature study. For the elaboration of specific training measures based on the needs, already existing training programmes will be analysed in the next step in order to develop training measures complementing the already established training programmes. The needs assessment and programme elaboration will be done within CAPITAL, but in parallel to the elaboration of the CAPITAL capacity programme itself. The professional end-user training will be combined with the activities of the IRU academy, in order to ensure that the target group will be reached in an appropriate way. Therefore, no specific training programme for professional end-users is planned within CAPITAL.

**Following the aforementioned approach, the main focus of the analysis of the training needs will be on public authorities and transport operators and fleet owners as main trainees.** The needs of professional end-users will also be discussed but not considered in development of the CAPITAL capacity building programme.

In order to elaborate recommendations for building a collaborative capacity community and deployment programme that supports ITS stakeholders in the implementation of (C-)ITS with targeted training on different levels, these training needs and knowledge gaps of the focused stakeholders have to be assessed and analysed in an appropriate way. This part of the deliverable describes the methodical approach CAPITAL has applied to collect and analyse the data concerning “Capacity needs and knowledge gaps of ITS Stakeholders” and summarizes the main results of the analysis.

### 2.1.1. Objectives of the data collection

The data collection process was performed in several steps, using different input and data sources. Both qualitative and quantitative methods were applied, selected according to their suitability to the available data. The underlying goal was to collect information on stakeholders’ capacity needs and knowledge gaps from different EU Member States to guarantee the geographical coverage and from the different CAPITAL stakeholder groups as defined in deliverable 2.1.

We decided to use this step-by-step approach in order to create a common understanding of the already existing competence in the consortium and on the existing and expected needs by doing this self-assessment in the first step, involve the stakeholders in the second step with an extensive web-
based questionnaire and finally deepen the understanding of the received answers and to cover target groups that were not involved before.

The main idea of the self-assessment of needs was to create a common understanding of the already existing competence within the consortium, as well as on the existing needs and by the partners expected needs in order to develop a comprehensive picture of the partners and the partners’ views. In addition, the results were compared to the outcomes of the interviews and the web-based questionnaire during the analysis phase to have some cross-check.

The web-based questionnaire was designed in order to identify most crucial deployment priorities of ITS from the view of the public sector and best-practices cases as well as major challenges that hinder further ITS deployment. In addition specific training interests were collected. These data feed into the activities of task 2.2. for the identification of the training needs. The survey was especially designed to reach public authorities, transport operators, transport related service operators, ITS Associations and ITS experts with different levels of know-how. In addition the questionnaire covered additional information on best-practice cases and business models as input for the WP3, but also for task 2.3..

This web-based questionnaire included as one main element an assessment of priority topics. The underlying agenda of this priority topics assessment was to identify possible differences on geographical level or between different groups of stakeholder in regard to the existing ITS priorities. These priorities will have an impact on the content of the CAPITAL training programme and can influence the different training measures and their specific focus. So even if C-ITS is a core topic of CAPITAL and specific training tools for this topic will be elaborated, we have to consider different priorities within Europe. As some European countries, especially the Western European countries as UK, Germany, France etc., are forerunners in the area of ITS that have already deployed a number of different services, C-ITS is a high priority at the moment. C-ITS is a cross-cutting issue, that also builds on already existing ITS deployments. In other parts of Europe (especially in the Eastern part of Europe) countries need to focus on other topics first before they can start the deployment of C-ITS services. Depending on the different national conditions and policy goals, it is possible that different priorities exist. To find out whether there are different priorities and what these priority topics are, the section on assessment of priority topics was included in the questionnaire. Furthermore, the analysis was carried out to identify differences in the priorities of ITS starters and highly experienced ITS practitioners.

The main objective of the in-depth interviews was to get a more detailed insight on the needs of the different CAPITAL stakeholder communities and to obtain the views and expectations regarding training needs in the ITS sector, as well as know-how gaps and the view on priorities and barriers of those groups not explicitly targeted by the questionnaire (e.g. research institutions).

The idea behind the organisation of the Special Interest Session during the ITS Europe Congress in Strasbourg in June 2017 was to identify the barriers and challenges for deployment and to have a deeper look at the differences between Western and Eastern parts of Europe. Therefore five different speakers from different parts of Europe were invited presenting their views on challenges and barriers to C-ITS deployment. Furthermore speakers were asked to present their view on
training needs in this respect. The results of the Session were also input for cross checking and deeper understanding of the stakeholders’ needs.

2.1.2. Data collection

As described in the previous subchapter the data collection was performed step-by-step. In general, the main steps of data collection regarding the capacity needs and knowledge gaps could be summarized as follows:

- Step 1: Self-assessment of needs within the project consortium
- Step 2: Web-based questionnaire especially targeted to public authorities, transport operators, transport related service operators, ITS Associations and ITS experts with different levels of know-how
- Step 3: In-depth interviews with selected key stakeholders and additional direct input from stakeholders (e.g. in the Special Interest Session at the ITS World Congress in Strasbourg)

For the analysis of the existing knowledge gaps and the capacity needs, different analysis procedures were selected according to the different type of data received. The questionnaire was the most formalised and structured tool. The answers were analysed by quantitative statistical analysis methods. Furthermore, the analysis of the questionnaire covers the largest area of questions, starting from the different stakeholder groups addressed, to the priority topics and furthermore to the barriers and specific training aspects. Therefore, the following analysis will start with the web-based questionnaire and the analysis of the results. These results are compared to the outcomes of the other data collection steps like the self-assessment and the interviews as a kind of comparison in the following chapters. Aligned to this the methods used for the analysis of results is at first described for the web-based questionnaire, followed by the interviews and the self-assessment.
2.1.3. Methods

2.1.3.1. Methods used for analysis of the web-based questionnaire

The web-based questionnaire was the main tool for collecting priorities, barriers and specific training needs from a larger group of respondents. The web-based questionnaire is documented in the Annex to this document and the main content and the structure is documented in the following subchapters.

Content and structure of the questionnaire

The survey was especially designed for public authorities, transport operators, transport related service operators, ITS Associations and ITS experts with different levels of know-how. Especially for those who are completely new to the area of ITS, a definition of the term and very basic questions were included in order to identify the training needs for those who are completely new to the topic. The main goal of the questionnaire was to identify most crucial deployment priorities of ITS from the view of the public sector and identify best-practices cases as well as major challenges that hinder further ITS deployment. At the same time this questionnaire aimed to determine the current level of already existing ITS expertise as well as know-how gaps in different topics to enable CAPITAL to assess specific training needs and priorities.

The main information gathered by this questionnaire was:

- Priorities within different ITS deployment topics/fields;
- Collection of best-practices and business models your country/organisation;
- Difficulties that hinder deployment;
- Existing knowledge gaps and training needs.

In addition, the questionnaire covered the following sections:

- **About the organisation**, including questions on the type of organisation and the geographical level the organisation is operating at in order to distinguish between regional differences or stakeholder specific characteristics.
- **Self-assessment on ITS know-how**, including a description of the different levels of know-how and the self-categorisation of the respondent.
- **Assessment of priority topics** is a section especially designed for those respondents that categorized themselves as 1st level ITS starters. The section includes a list of priority topics. Respondents were asked to tick those topics that are of high priority in their region, country, or area of influence. For every main area and subtopic, a short definition was included to make it easier for the ITS starters. Additional high priority topics could be added as free text.
- **Assessment of priority and deployment topics** for those respondents that categorized themselves as 2nd or 3rd level ITS experts, including a matrix for the same priority areas as 1st level respondents (see before), with the possibility to tick for every topic (not only priority topics) if they have already deployed or are currently deploying a service in this area. Similar to the questions to the 1st level respondents, short descriptions for every area and subtopic were included.
- **Identification of major challenges** (only for respondents that assessed themselves as 2nd and 3rd level ITS experts). This section collected information on difficulties that hinder the deployment of ITS, in order to find out were potential training could help to overcome these challenges and foster the implementation. In addition to a number of proposed barriers, respondents were able to add barriers they experienced themselves as free text.

- The **best-practices and business models** section was only directed to 2nd and 3rd level ITS experts and focused on their experiences and learnings. The results of this section provided input to task 2.3. and WP3. The questions focused only on those ITS applications that have been fully deployed and covered the business –model behind the ITS application.

- A separate section on **specific training needs** directed to all respondents covered questions on the main interests for training (e.g. general introduction, technical standards, procurement of ITS, evaluation and cost-benefit analysis for ITS, etc.), as well as preferred learning tools (e.g. online courses, webinars, face-to-face workshops, etc.).

In the following table the different sections are presented related to the different know-how levels that the respondents were asked to answer:

<table>
<thead>
<tr>
<th>Questionnaire section to be answered</th>
<th>1st level</th>
<th>2nd level</th>
<th>3rd level</th>
</tr>
</thead>
<tbody>
<tr>
<td>About the organisation</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>(no categorisation of levels yet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Self-assessment on ITS know-how</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>(no categorisation of levels yet)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment of priority topics</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assessment of priority AND</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>deployment topics</td>
<td></td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Identification of major challenges</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>best-practices and business models</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>specific training needs</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

Table 1: Questionnaire section differentiated to know-how levels

The priority topics were assessed differently in the web-based questionnaire. Depending on the self-assessment of their ITS know-how the respondents received two different types of question-sets for the assessment of priority topics. While respondents that identified themselves as ITS starters (1st level) only could indicate their priorities in a more simplified way, the respondents who identified
themselves as 2nd and 3rd level ITS experts received a matrix combining the priority topics with the indication of already existing deployments.

For the further analysis only the answers regarding the assessment of priority topics was considered. All respondents, independently of their ITS know-how were requested to indicate the high priority topics according to the similar list of topics. In order to do so, a selection list of seven main topics was provided to them, containing a list of subtopics, namely:

- Traffic management and network control
  - Traffic control in urban areas
  - Traffic control on high level road network
  - Parking management and access control
  - Travel demand management
  - Collection of emission data for local traffic diversion
  - Road-rail intersection
  - Integrated Traffic Management

- Traveller Information Services
  - Journey planning for individual road transport
  - Journey planning for rail transport
  - Journey planning for public passenger transport
  - Multimodal journey planning
  - Integrated, electronic fare management
  - Services based on vehicle sharing concepts

- Emerging Services - Cooperative ITS
  - C-ITS on high level road network
  - C-ITS in urban areas

- Access and Management of Data
  - Event detection and transport data collection
  - Aggregation and management of transport data
  - Access to static transport data
  - Access to dynamic transport data
  - Set-up and management of a National Access Point

- Passenger transport services
  - Operations and fleet management
  - Transport demand management
  - Communications for passenger transport operations management
  - Safety and security for passenger transport
  - Automated fare collection

- Maintenance and Construction Management
  - Vehicle tracking and maintenance
  - Weather Data Collection, Processing and Dissemination
  - Winter Maintenance Operations Support
The priority topics selected were based on the categorisation of the World Road Association – PIARC related to ITS topics. The respondents could select as many topics as were necessary to them by ticking the topic. Apart from the aforementioned topics the respondents were given the opportunity to indicate any additional high priority topics that are not included in the aforementioned list, in the form of free text.

Implementation of the questionnaire
The questionnaire was implemented as a web-based questionnaire, using the Questionpro online tool. The tool enabled also customized questions according to the self-assessment of ITS know-how. The basic version was implemented in English. In addition, a German, Greek, Italian, Spanish and French version were implemented. Screenshots of the English version (Figure 2 and Figure 3) and of the Greek version (Figure 4) can be seen in the following.
Figure 3: Screenshot of the English version of the web-based questionnaire (Specific training needs)

Figure 4: Screenshot of the Greek version of the web-based questionnaire (Assessment of priority topics)
Distribution of the questionnaire
The questionnaire was distributed via many channels in order to reach a high number of participants, to ensure a sufficient amount of responses for the statistical analysis and furthermore to achieve a large geographical coverage in Europe.

A very rough estimation of the consortium was done and showed that at least 29,244 persons received the link to the questionnaire by e-mail or newsletter from partners of the consortium. This included a number of partner organisations and relevant projects in the ITS area, the networks of the different European ITS Associations (not only inside the consortium as TTS Italia and ITS Hellas, but also Connekt, ITS Sweden, ITS Finland, etc.), national and international city associations (e.g. Austrian association of cities and towns, POLIS, EUROCITIES). Partners like the FIA reached all of their members via direct mailings and newsletter. In addition other sources were used e.g. social media (e.g. IRU Academy LinkedIn group with more than 1800 members and the smart mobility.at platform with around 900 users only in May 2017).

The English version of the questionnaire was circulated beginning with 4th of April 2017. The translated versions were followed step by step in April and May 2017. The questionnaire was open for answers until 28th of May 2017.

Methods for analysis of the questionnaire results
The questionnaire was expected to provide a data set which can be used to calculate how many times the different barriers included in the questionnaire have been mentioned by different types of stakeholders, stakeholders operating on local, national or European level and stakeholders on various levels of know-how on ITS. Comparisons between groups were done by using the chi-square test for independence.

Cross tabulations between variables and the related chi-square tests of independence were the basis for the analysis. In case of 2x2 tables, values of the chi-square test were calculated with continuity correction. The chi-square test of independence indicates whether there is a statistically significant association between two categorical variables, but it does not tell which of the categories are different from others and how much. The effect size was studied by calculating Cramer’s V for the contingency tables. Frequencies of responses summarised as contingency tables were used for interpreting the results also in situations in which the sample size was too small for chi-square test or in which the results were not statistically significant.

2.1.3.2. Methods used for analysis of the in-depth interviews
For the interviews, key stakeholders from the main target groups were selected carefully according to their know-how and experience in the ITS sector, as well as due to their country (to cover also geographical differences). In addition, some interviews with core stakeholders from the main trainee group public authority (especially cities) were done, covering the different levels of know-how. This group has been identified as one of the key target groups of CAPITAL, and therefore the in-depth interviews with these externals are extremely useful for the elaboration of training programmes. In addition, it has to be considered that the dissemination partners will not be directly involved in the
training (as trainees or partners for exchange), and they were consequently excluded from the needs analysis.

In general the well-thought selection of the interview partners followed some general rules:

- It was important that the main target group of public authorities is covered to get an insight on their motivations and reveal the concrete topics for training. Therefore the consortium decided to cover all ITS know-how levels within the stakeholder group public authorities.
- From the stakeholder group of transport operators and fleet owners a Finish fleet owner was invited for the interviews in order to get insight on this specific group. Transport operators are already covered by the questionnaire, but also by the Special Interest Session.
- Knowledge providers as universities and research institutions were invited to the interviews as it is important to get their insight view on the training concept and the training needs. The basic idea of CAPITAL is a peer-to-peer learning concept, but in the area of training universities and research institutions play an important role.
- One data and service provider was included in the in-depth interviews, as they have a special role in the (C-)ITS deployment. Although data and service providers are classified as suppliers in the CAPITAL functional distinction they are closely connected with the transport operators. Due to their special characteristics the have been invited for an in-depth interview.
- Suppliers in general were excluded from the interviews so far. In the current step the consortium focused on the needs and capacity gaps of the stakeholder groups that will be trainees in the first step. As suppliers will be involved only for know-how exchange they have not been in the focus of the current activity. If necessary the supplier needs will be investigated in the later phase of the project.

The Quality Expert Interview Method (Gläser and Laudel 2010) was used for planning and performing the in-depth interviews. The method was chosen for in-depth interview to allow comparison to the results of the questionnaire and the self-assessment:

To fully assess the needs and knowledge gaps, qualitative expert interviews are essential, especially, because “knowledge gaps” cannot be determined via desk research and similar methods. Partially structured interviews and structured catalogues of questions were used to achieve results that are comparable to the questionnaire. The questions were based on the web-based questionnaire but formulated in a simpler way in order to open the space for more detailed answers. The interviews performed were expert interviews according to the following definition: “An expert is not just a person in a high job position, but all people, that dispose over knowledge that helps to solve the research question, or is considered as expertise in the field of interest. Mostly they are personally working in the field of interest and, through their experience, own special knowledge in this field. In an expert interview these experts are sharing their knowledge.” (Gläser and Laudel 2010).

Short in-depth interviews (30-45 minutes maximum) were mainly done via phone or as face-to-face interviews by different CAPITAL partners (AustriaTech, CERTH, City of Helmond, TTS Italia and VTT). As mentioned before it is important to obtain results comparable to the questionnaire. In order to ensure harmonised results and partly structured interviews, so-called “interview guidelines” were developed and provided to the partners. The guidelines presented in the Annex to this document.
The questions and the coding of the analysis were designed in a way to cover areas corresponding to the questionnaire, so that results of the interviews will provide a more detailed insight view and complement or explain answers provided in the questionnaire. The questions of the interviews covered the following topics:

- The professional background of the interview partner and his or her relation to the topic of (C-)ITS
- Thematic priorities for the area of ITS
- Experienced and perceived barriers for ITS
- Priorities regarding training topics and tools
- Additional input on key stakeholders for CAPITAL

The interview guidelines varied slightly depending on the stakeholder groups the respondent had been assigned to.

The interviews took place between May and June 2017. In total, 9 interviews were carried out (listed in chapter 2.2.2). These phone or face-to-face interviews served as input for the training material and provided better insight into training needs. The interviews were transcribed and coded according to the qualitative content analysis (QCA) that will be described more in detail in the following paragraph. The aim was to identify the priority topics, main barriers and specific training interests and training tools that would be necessary to overcome the barriers. In addition it was evaluated who are the most important group that should be trained from the view of the interviewees.

The interviews were analysed with **qualitative content analysis (QCA)** (Gläser and Laudel 2010). This is a systematic and rule guided approach to analyse texts per analysing categories. This approach combines qualitative methods and quantitative logic and is suitable for a mixed methods analysis, like provided in this deliverable.

The interviews were transcribed. **QDA miner Lite software (free edition)** was used for the data analysis. This kind of software is often used for mixed methods research as it was done in the case of our analysis of capacity needs and knowledge gaps in the field of C-ITS and ITS.

Mixed Methods research is not a new movement, but it puts different steps of analysis with their different, logics (qualitative and quantitative) together (Mayring 2014; Rodik and Primorac 2015).

The core of the qualitative content analysis is assigning parts of the material to categories of a coding frame. The basis for the coding frame of this analysis were the questions included in the questionnaire. The codes were chosen in a way that guaranteed comparability of results between interviews and the questionnaire. Additional codes were added for extra information that was not covered by the questionnaire. Examples of these include the code “peer-to-peer”, which covers all comments of interviewees about the peer-to-peer concept of capital, or the code “policy barrier” as one of the barriers. In the questionnaire, the policy barrier or the often mentioned “lack of coordination” were included in the category “other barriers”. Because the interview partners mentioned “lack of coordination” as a policy barrier very often, a code was introduced.
To sum up, the categories were set in a deductive way, by using codes, which are comparable to the results of the quantitative web-based questionnaire. The code book of the interviews with descriptions of the codes is presented below. The codes in black directly relate to the web-based questionnaire, in blue ones are additional codes which were created to allow extra analysis options:

**CODEBOOK INTERVIEWS CAPITAL**

**CODE01 - Priority Topic**
- CODE01/01 Access and Management of Data
- CODE01/02 Additional High Priority Topics
- CODE01/03 Emerging Services - C-ITS
- CODE01/04 Freight Services
- CODE01/05 Maintenance and Construction Management
- CODE01/06 Passenger Transport Services
- CODE01/07 Traffic Management and Network Control
- CODE01/08 Traveler Information Service

**CODE02 - Barriers**
- CODE02/01 Authorities not Willing
- CODE02/02 Best Organisational Structure/Business Model Unknown
- CODE02/03 Cost Benefit Unknown
- CODE02/04 High Risk
- CODE02/05 Lack of Resources
- CODE02/06 Lack of Technical Knowledge
- CODE02/07 No Barriers
- CODE02/08 Not on the Agenda of Politicians
- CODE02/09 Other
  - 02/09/01 Policy Barrier
  - 02/09/02 Lack of Standards (the lack of standards was often mentioned as barrier especially in C-ITS, to analyse it according to the questionnaire and make it comparable the code was added as extra barrier)
  - 02/09/03 Other
- CODE02/10 Procurement to Complex, Model Missing

**CODE03 - Main Area of Interest (for Training)**
- CODE03/01 Best-Practice Cases
- CODE03/02 Business Models
- CODE03/03 Evaluation Methods and Cost Benefit Analysis of ITS Services
- CODE03/04 Financing and Funding Opportunities
- CODE03/05 General Introduction on the Topics
- CODE03/06 Legal Issues
- CODE03/07 Other Training Interests
  - 03/07/01 Cooperation Ecosystems (The need for a collaborative Ecosystem was mentioned and added as subcategory of other training interests)
  - 02/07/02 Other
- CODE03/08 Procurement Models
- CODE03/09 Relevant Technologies and Standards

**CODE04 - Type of Training**
- CODE04/01 Get Training Material
- CODE04/02 Online Courses
- CODE04/03 On-site Visits
- CODE04/04 Other Kind of Training
- CODE04/05 Participation in Workshop
- CODE04/07 Peer-to-Peer (this code was added to analyse additional comments about the peer-to-peer model)
- CODE04/06 Webinars to Specific Topic

**CODE05 - Training Target Group**
- CODE05/01 Knowledge Providers
- CODE05/02 Other Groups
- CODE05/03 Prof. Users
- CODE05/04 Public Authorities
- CODE05/05 Transport Operator/ Fleet Owner
2.1.3.3. Methods used for analysis of the self-assessment

As already mentioned in the introduction to this chapter, the self-assessment of needs complemented the results collected by the web-based questionnaire and the in-depth interviews.

The self-assessment of needs was done within the CAPITAL consortium. The consortium members of CAPITAL themselves represent a well-balanced team of public authorities, research institutions, end users, commercial operators, ITS associations and stakeholder platforms. They are experts in the ITS sector and can therefore identify and exemplify the capacity needs and knowledge gaps of ITS stakeholders.

In order to make use for CAPITAL based on this expertise and information the consortium partners can provide for the analysis needs, a template for self-assessment was developed and distributed within the consortium. In addition the self-assessment template was used to collect additional information on business cases, best practice cases (mainly as input for task 2.3. and WP3) as well as additional sources for needs assessment (like documents, studies etc.). The template is attached as Annex to this document.

The template for self-assessment covered the following questions:

- **What kind of expertise can you contribute, that can be used in the training?**
- **What kind of best practices of ITS (C-ITS) Deployment or business models do you wish to share within CAPITAL that you consider interesting for others?**
- **What kind of needs for training do you see in your country?**
- **What kind of existing documents, studies and projects do you know about, that will be a good starting point for the status quo and needs evaluation?**

The main focus of the analysis carried out here was on the training needs. In order to elaborate further training recommendations, the question on expertise of the consortium partners was also investigated in detail. All other questions in the self-assessment template are covered by WP3 and are not discussed in detail in this deliverable.

The self-assessment of needs was received as written input from the partners. The self-assessments of FIA and ERTICO are not included in this analysis. Due to their organisations’ mission and structure, they are intermediaries for expertise through their members but they will not provide training themselves. Therefore, they were excluded from the self-assessment of needs.

The self-assessment provided a data set of written and structured data. This data set was analysed with **qualitative content analysis (QCA)** (Gläser and Laudel 2010), which was used also for analysing
the results of interviews. The categories used in the analysis the results of self-assessment were the same as the ones used when analysing the results of interviews (see chapter 2.1.2.3). In particular, CODE01 “Priority Topic” and CODE03 “Main Area of Interest” were used to code the self-assessment of needs.

This allows comparison between the results of self-assessment with the results of interviews as well as with the web-based questionnaire. The codebook of the self-assessment is presented below:

**CODEBOOK SELF-ASSESSMENT CAPITAL**

**CODE01 - Priority Topic**
- CODE01/01 Access and Management of Data
- CODE01/02 Additional High Priority Topics
- CODE01/03 Emerging Services - C-ITS
- CODE01/04 Freight Services
- CODE01/05 Maintenance and Construction Management
- CODE01/06 Passenger Transport Services
- CODE01/07 Traffic Management and Network Control
- CODE01/08 Traveler Information Service

**CODE03 - Main Area of Interest (for Training)**
- CODE03/01 Best-Practice Cases
- CODE03/02 Business Models
- CODE03/03 Evaluation Methods and Cost Benefit Analysis of ITS Services
- CODE03/04 Financing and Funding Opportunities
- CODE03/05 General Introduction on the Topics
- CODE03/06 Legal Issues
- CODE03/07 Other Training Interests
  - 03/07/01 Cooperation Ecosystems (The need for a cooperative Ecosystem was mentioned and added as subcategory of other training interests)
  - 02/07/02 Other
- CODE03/08 Procurement Models
- CODE03/09 Relevant Technologies and Standards

2.1.3.4. **Methods used for analysis of the professional end-users’ needs**

The assessment of the needs of professional end-users - defined here as professional drivers - was addressed by IRU by with a brief literature study, considering e.g. current studies and reports on road safety. These results were presented and discussed in a special session at the ITS Europe Congress in Strasbourg in June 2017. The results of the literature study and the special session are summarised in chapter 2.2.3.

2.1.3.5. **Methods used for analysis of additional input sources**

Besides the aforementioned tools (web-based questionnaire, in-depth interviews and self-assessment of needs), some additional activities were carried out to collect information on the knowledge gaps and capacity needs of the ITS stakeholders.

A major activity in this context was the Special Interest Session organised by the CAPITAL consortium as part of the ITS Europe Congress in Strasbourg in June 2017.

The Session on the assessment of capacity needs of public authorities and transport operators in the area of C-ITS took place in Strasbourg during the ITS European Congress on the 21st of June 2017.
(SIS32 – (C-)ITS for public authorities: challenges and barriers to deployment – from West to East and t is scheduled on Wednesday 21 June 2017, 11:00 – 12:30). DG MOVE moderated the sessions and five confirmed speakers covered the East and West areas of Europe. The main focus of the session was to gain a deeper insight especially on the capacity needs of public authorities and the barriers they perceive regarding the deployment of C-ITS and related differences between Western Europe and the Central and Eastern European countries.

The main inputs, discussion points and conclusions are summarised in the chapter 2.2.4. These conclusions will also be taken into consideration when comparing the results from all available sources and deriving the needs of the different stakeholder groups and later on the recommendations for the further training programme.
2.2. Analysis of capacity needs
The outcomes from the different steps and input sources, as described before, will be analysed in detail in the following subchapter.
The analysis starts with the results from the web-based questionnaire, followed by the in-depth interviews and concluded by the self-assessment. In addition, the conclusions of the Special Interest Session are summarised within the following.

2.2.1. Results of the questionnaire

General statistics on the received answers
In total, 331 responses were received to the web-based questionnaire. This figure includes also cases in which questionnaire was viewed with a web browser but was filled in only partially or not at all.
In order to ensure exploitable results and avoid double counting of answers, only fully completed questionnaires were included in the statistical analysis presented in the following chapter.
After excluding blank and incomplete responses, the data set to be analysed included 117 fully completed questionnaires. 85 respondents answered the English version, 22 the Greek version, 9 persons the German version and 1 person the Spanish version.

The questionnaire differentiated between 3 different know-how levels:
- 1st Level - ITS start-up communities: You have no or very limited know-how on the deployment of ITS. Your main question is “what is ITS and why is it relevant for me?” Pick this level also if you are a public sector decision-maker in an European Member State with very few or no dynamic traffic management systems and with limited or no real-time traffic information services. Also pick this option if you answer on behalf of cities without urban ITS measures (except traffic lights).
- 2nd Level - advanced and intermediary communities: You already gained some experience or familiarity with different ITS systems or already deployed ITS applications/services in your sphere of influence. Your main question is “how can I use ITS technologies in an optimum way and which actions should be taken to realise the potential of ITS?”
- 3rd Level - train the trainer/ highly experienced communities: You have extensive experience in research and deployment of ITS technologies. Pick this level also if you either already trained others in ITS topics or are interested (based on your experience) to develop such a capability. Your main question is “what should I advise or encourage others to do in regards to ITS deployment and research?”

All levels of know-how were represented in the responses, but 47% of the respondents (55 out of 117 respondents) assessed themselves as 2nd level ITS experts and 29% of the respondents (34 of 117) assessed themselves as 3rd level ITS experts (therefore 89 persons in total account 2nd and 3rd level respondents).
As stated before, the two main target groups of the planned CAPITAL training programme are public authorities and transport operators and fleet owners. Looking at the distribution of the respondents, we could see that most respondents belong to these target groups, as 44% (52 out of 117) of the respondents are from the public side (as public administration or authority).

The questionnaire distinguished four regional levels: local, regional, national and international. 36% (42 out of 117) of the respondents are active on national level, followed by organisations with a local sphere of influence (26% or 31 of 117).
When having a deeper look in the main target group of public authorities, one can see that most respondents (50%) categorized as public authorities are cities or municipalities (26 out of 117).
Looking at the geographical coverage, answers were received from 21 countries (Albania, Austria, Belgium, Croatia, Czech Republic, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Nigeria, Qatar, Slovenia, Spain, Sweden, the Netherlands, Turkey, and United Kingdom. In further analysis, it has to be considered that a high percentage of responses were received from the Great Britain (GB) (28 responses) and Greece (26 responses), followed by Finland (13), Austria (10), Italy (9) and the Netherlands (8). The distribution is displayed in the following figure (Figure 9). The shares of countries appear in the figure in alphabetical order.

![Geographical diversion of the respondents](image)

*Figure 9: Overview of the geographical diversion of the received questionnaire responses*
The respondents were also requested to assess the priority topics, the barriers to ITS deployment, the main training interests, as well as to indicate the preferred training tools. The analysis of their responses is provided in the following sections.

When planning the questionnaire, we expected respondents on knowledge levels 2 and 3 to have more detailed information on their priority topics than level 1 stakeholders with limited knowledge and no experience with deployment of ITS. Due to this fact the analysis of the priority topics was split into 1st level and 2nd/3rd level. For the further recommendations the priorities of 1st level respondents are as important as for the other two levels.

In total 89 respondents assessed themselves as 2nd or 3rd level ITS experts. 43 out of the 89 respondents (48.31%) indicated event detection and transport data collection as the topic with the highest priority, followed by safety and security for passenger transport and multimodal journey planning topics, that were selected by 36 of the 89 respondents respectively (accounting 40.45%). The road-rail intersection, as well as the collection of emission data for local traffic diversion were rated as the topics with a lower priority comparing to the others, as they were selected by 12 (13.48%) and 15 (16.85%) respondents respectively. The overall results are presented in the following chart.
Next, we explored the relationships between priority topics and respondents’ characteristics (organisation type, knowledge level and regional level).

Chi square test of independence was used to identify statistically significant associations between priority topics and respondents’ characteristics. In case of 2x2 tables, values of chi-square test were calculated with continuity correction. In addition, Cramer’s V was to determine effect size. Again, the analysis was carried out for the data set including only fully completed responses provided to all language versions of the questionnaire (117 responses). The data supplied as an excel file was
copied to SPSS which was used to make the calculations. The analysis was carried out for 89 responses (2nd and 3rd level responses). The statistically significant results are discussed hereafter:

First, we studied the associations between the type of organisation and the selected high priority topics. The analysis did not provide any statistically significant results, leading to the assumption that either there is no association between the two variables, or that the small sample size does not allow revealing any statistically significant correlation.

Second, we analysed associations between the regional level and the selected high priority topics. Again the analysis did not provide any statistically significant results, leading to the assumption that either there is no association between the two variables, or that the small sample size does not allow revealing any statistically significant correlation.

Third, we studied the associations between the know-how level and the selected high priority topics. In this case the analysis revealed some statistically significant results, showing that there is a correlation between the two variables. More specifically the following statistically significant relationships were found in cross-tabulation and related chi-square tests of independence.

- Know-how level <=> High-priority topic - Corridor/area wide traffic control and management (p = 0.04, Cramer’s V = 0.243)
- Know-how level <=> High priority topic - C-ITS on high level road network (p = 0.022, Cramer’s V = 0.266)
- Know-how level <=> High priority topic - Aggregation and management of transport data (p = 0.043, Cramer’s V = 0.239)
- Know-how level <=> High priority topic - Access to static transport data (p = 0.006, Cramer’s V = 0.314)

The following relations were not statistically significant according to chi-square test (with continuity correction in case of 2x2 tables), but significant according to Fisher’s exact test or chi-square test of independence without continuity correction:

- Know-how level <=> High priority topic - Access to dynamic transport data (chi-square test with continuity correction: p = 0.065, Fisher’s exact test: p = 0.047, Cramer’s V = 0.219)
- Know-how level <=> High-priority topic - Set-up and management of a national access point (chi-square test without continuity correction: p = 0.031, chi-square test with continuity correction: p = 0.055, Fisher’s exact test: p = 0.051)
- Know-how level <=> High-priority topic - Urban freight management (chi-square test without continuity correction: p = 0.036, chi-square test with continuity correction: p = 0.062, Fisher’s exact test: p = 0.041)

To summarise, it can be stated that there is a statistically significant association between the 2nd and 3rd level ITS experts, regarding the topic of Corridor/area wide traffic control and management of C-ITS on high level road network, Aggregation and management of transport data, Access to static...
transport data, Access to dynamic transport data, Set-up and management of a national access point and Urban freight management.
The comparison between 2\textsuperscript{nd} and 3\textsuperscript{rd} level respondents showed that in those cases with statistical significant difference the topic was more important for 3\textsuperscript{rd} level ITS experts, than for 2\textsuperscript{nd} level respondents, as it is shown in the following figure:
Figure 11: Comparison of priority topics according to know-how level

CAPITAL D.2.2.: Capacity needs and knowledge gaps of ITS stakeholder groups and case study collection
Furthermore, the comparison of priority topics between level 2 and level 3 showed that 3rd level respondents assigned an average of 12.1 subtopics as high priority, whereas 2nd level respondent only assigned 8.9 subtopics as high priority.

In comparison, **28 respondents identified themselves as ITS starters and therefore 1st level respondents.** Those respondents answered the simplified questions regarding priority topics, as explained in the introduction to this subchapter.

When looking at the priority topics, no clear patterns could be observed. Some topics were mentioned more frequently than others by 1st stakeholders, but no statistical analysis was carried out separately for the group of level 1 stakeholders. Nevertheless, looking at the four most frequently assigned subtopics 24 out of 28 respondents (85.71%) see traffic control in urban areas as the most important topic, followed by access to dynamic transport data (with the same percentage). 22 out of 28 (78.57%) respondents voted for Integrated Traffic Management as high priority topic, the same number that voted for C-ITS in urban areas. The subtopics Road-rail intersection, as well as automated fare collection were selected by 6 (21.43%) and 8 (28.57%) 1st level respondents.

The priorities are displayed in the following figure.
Figure 12: Distribution of priority topics of 1st level respondents

In average, each 1st level respondent assigned 17.75 subtopics as high priority.
In addition 19 respondents (3 from 1st level) added some topics they were missing in the list of priority topics. Two topics were mentioned more than once, as they were:

- Connected and autonomous vehicles or connected autonomous driving, incl. truck platooning
- Use of ITS/C-ITS for specific challenges (e.g. with tunnels and bridges, for special groups like vulnerable road users, dangerous goods, emergency services, for special cargo transportations, etc.)

In addition a variety of topics was mentioned as free text, namely:

- Generation of funds
- Deployment and maintenance of ITS
- Use of street lighting infrastructure (CMS) for traffic count, weather monitoring, air quality monitoring, or advertising local services
- Weather and road condition notifications for road users
- Road Safety
- Traffic safety measures with continuous data collection for follow-up
- Risk analysis for route planning
- Demand based priority for public transport / electric vehicle users
- Facilities and services for disabled travellers
- Electromobility
- Business models for urban goods logistics and people movers integrations
- Climate-neutral vehicles
- V2I and I2V infrastructure and operation
- Journey planners for regions to encourage modal shift, incl. feedback options for constant improvement of data and usability
- National ITS Corridors and Coordination with Major Events
**Major challenges and difficulties that hinder deployment of ITS applications**

The respondents who identified themselves as 2nd and 3rd level ITS experts were requested to indicate the major challenges that could potentially hinder further deployment of ITS applications. In order to do so, a selection list of seven potential barriers was provided to them to choose from, namely:

- The knowledge required for the technical implementation is not available
- The cost and benefits of such a system are not known
- The procurement is too complex or an adequate model for procurement is missing
- The best organisational structure/business model for such a system is not clear
- There is a lack of resources to finance further implementation
- Politicians do not see it as a goal at the moment
- Authorities are not willing to deploy this solution
- The risk is too high

Apart from the aforementioned potential challenges the respondents were given the opportunity to indicate any additional barrier not included in the aforementioned list (or if they do not see any barriers towards further deployment), in the form of free text.

In total 89 respondents assessed themselves as 2nd or 3rd level ITS experts. 53 out of the 89 respondents (59.55%) perceive that when the “cost and benefits of such a system are not known” is a major challenge that could hinder the further deployment of the respective ITS application/system, followed by “best organisational structure/business model for such a system is not clear” and “lack of resources to finance further implementation”, that were selected by 41 (46.06%) and 38 (42.69%) respondents respectively. Issues such as “authorities are not willing to deploy this solution”, as well as “high risk” is associated with the deployment were not seen as major barriers by majority of the respondents. These cases were selected by 12 (13%) and 4 (4%) respondents respectively.

Although only few respondents perceived “authorities are not willing to deploy this solution” or the “high risk” as a major challenges, most of the respondents who indicated these barriers added also some additional comment as free text to provide more detailed information on them.

Respondents mentioned that especially on political level, clear information is needed before the investments are made in ITS. The missing knowledge on specific costs and especially the awareness and know-how on the benefits of ITS solutions and the often missing business cases are reasons for this challenge. In that case often available financial resources are often used for upgrading traditional infrastructure, instead of investment in new innovative solutions, like ITS. Also the role of the public was mentioned, as public acceptance concerning data collection, processing and publication is one of the reasons for authorities for being very careful when it comes to ITS deployment. Furthermore, it was mentioned that the benefits could not be proven in advance due to often missing appropriate structures for testing or developing new equipment in a real life setting.

In addition, the risk of uncertain legal frameworks regarding the obligation to collect data and methods of data provision cause some challenges for ITS deployment.
The involvement of many different actors with various levels of knowledge in the deployment of ITS is causing additional challenges related to coordination. Another identified barrier in this context was mentioned by different respondents: The need for a multi-agency cooperation and coordination. Nevertheless, this kind of cooperation is often not foreseen in the existing processes and it may therefore be a barrier for ITS deployment. Lack of coordination and cooperation can furthermore lead to ineffective ITS deployment (with only sporadic implementations) without or with rather local effects. Furthermore, it was mentioned here that the “silos” with the organisations of the relevant stakeholder (especially regarding public authorities) hinder the access to relevant data for further ITS services.

The overall results regarding the question on major challenges and difficulties are presented in the following chart. The figure illustrates the shares of respondents who mentioned each of the barriers for ITS deployment (only respondents on know-how level 2 and 3).

![Figure 13: Assessment of major challenges and difficulties that hinder deployment of ITS applications](image)

The analysis was continued by exploring the relationships between self-reported barriers for deployment and the stakeholder related background variables (organisation type, know-how level and regional level).
First, crosstabulations were made between challenges (barriers) for deployment and stakeholder related background variables. Chi-square tests of independence were then calculated to find statistically significant associations between the crosstabulated variables. Finally, Cramer’s V was calculated to find out the effect size. Again, the analysis was carried out for the data set including only fully completed responses provided to all language versions of the questionnaire (117 responses). The data supplied as an excel file was copied to SPSS which was used to make the calculations. The analysis was carried out for 89 responses, after respondents with know-how level 1 (no one of whom had reported any barriers for ITS deployment) had been excluded. The statistically significant results are discussed hereafter.

First, we studied the associations between the type of organisation and the challenges indicated by respondents. The analysis did not provide any statistically significant results, leading to the assumption that either there is no association between the two variables, or that the small sample size does not allow revealing any statistically significant correlation.

Second, we analysed the associations between the regional level and the challenges. The following statistically significant relationships were found:
- Regional level <=> The costs and benefits of such a system are not known (p = 0.012, Cramer's V = 0.352)
- Regional level <=> There is a lack of resources to finance further implementation (p = 0.001. Cramer's V = 0.429)

Cramer's V measures the effect size. The values of Cramer's V indicate a moderate effect size in these cases (0.3 < Cramer's V <= 0.5).

When looking at these results, it can be stated the barrier regarding the unknown costs and benefits of such systems is especially true for organisations working at international (58%) or national level (52%) in comparison to organisations active on regional (22%) or local level (39%).

On the other hand, the lack of resources to further finance the implementation is especially perceived by organisations working at regional level, but also on local level, as 10 out of 18 (56%) respondents working at regional level perceived this as a major barriers, as well as organisations working at local level (as e.g. cities) where 15 out of 31 respondents (48%) voted for this as a barrier. In comparison, only 7 out of 42 respondents (17%) perceive this as a major barrier on national level.

Third, we focused our analysis on possible associations between the know-how level and the challenges for deployment indicated by respondents. The following statistically significant relationships were found:
- Know-how level <=> The knowledge required for the technical implementation is not available (p value with continuity correction = 0.009, Cramer's V = 0.304)
- Know-how level <=> The best organisational structure/business model for such a system is not clear (p value with continuity correction = 0.034, Cramer's V = 0.248)

The values of Cramer’s V indicate a moderate effect size in the first case (0.3 < Cramer’s V <= 0.5) and a small effect size in the second case (0.1 < Cramer’s V <= 0.3).
Specifically, in concrete 44% of the 3\textsuperscript{rd} level respondents see the missing knowledge required for the technical implementation as an important barrier, whereas only 16% of the 2\textsuperscript{nd} level respondents see this as important. Similar to this, 62% of the 3\textsuperscript{rd} level respondents perceived missing clarity on the best business model as an important barrier, in comparison to only 36% of the 2\textsuperscript{nd} level respondents.

In addition, the respondents had the possibility to add other barriers as a free text option. Some respondents mentioned data protection and data sharing as an additional barrier (especially the protection of personal data was mentioned). The complexity of the ITS implementation due to the fact of the need of involving multiple stakeholders was named by one respondent. Furthermore, public - private cooperation is perceived as one additional challenge for ITS deployment. Some respondents wished for more awareness and know-how on possible deployments. Legislation is also perceived as a challenge by some respondents. Furthermore the respondents named the lack of technical expertise across the sector as well as the need for more open interfaces as additional barriers.

**Main areas of interest (for training) and preferred training tools (type of training)**

All respondents including those who identified themselves as 1\textsuperscript{st}, 2\textsuperscript{nd} and 3\textsuperscript{rd} level ITS experts were requested to indicate their main interests for training. In order to do so, a selection list of was provided to them to choose from, namely:

- General introduction on the topics
- Financing and funding opportunities
- Evaluation methods and cost benefit analysis of ITS services
- Best-practice cases
- Legal issues
- Business models
- Procurement models
- Relevant technologies and standards
- I am not interested in a training

In total, 117 respondents replied to the questionnaire. Respondents were allowed to select a maximum of 4 areas of interest from a list by ticking a box. 74 out of the 117 respondents (63.25%) were interested in the “best-practice cases” training course, followed by “evaluation methods and cost benefit analysis of ITS services” which is preferred by 57.26%, while “Relevant technologies and standards”, ranks third, as it is preferred by 52.14%. It seems that the majority of the respondents are interested in training as the answer “I am not interested in training” was selected only a few times (8, accounting 6.84%), while the “Procurement models” is one of the training topics that the respondents seem to be less interested in, comparing to the other topics (it was indicated as an area of interest by 15 respondents, corresponding to 13% of all respondents). The overall results are presented in the following chart.
Moreover, all respondents, including those who identified themselves as 1st, 2nd and 3rd level ITS experts, were requested to indicate their preferred training tools. In order to do so, a selection list was provided to them to choose from, namely:

- Online courses
- Participation in webinars to very specific topics
- On-site visits
- Get training material (as flyers, folders and handbooks, etc.)
- Participation in workshops / face-to-face trainings (organised by public authorities)
- Participation in workshops/ face-to-face trainings (organised by industry)
- Participation in workshops/ face-to-face trainings (organised by research institutions)
- I am not interested in a training

In total, 117 respondents replied to the questionnaire. Respondents were allowed to select one or more training methods from the list by ticking a box. 66 out of the 117 respondents (56.41%) were interested in receiving training in the form of “participation in webinars to very specific topics”, followed by “participation in workshops / face-to-face trainings (organised by public authorities)” which is the preferred method for 62 respondents (52.99%), “participation in workshops/ face-to-face trainings (organised by industry)”, that is preferred for 61 respondents (52.14%). Again, it seems that the majority of the respondents are interested in training as the answer “I am not interested in a training” was selected only a few times (9 respondents corresponding to 8%). The overall results are presented in the following chart.

Figure 14 Assessment of main areas of interest (for training), stakeholders on know-how levels 1, 2 and 3
Finally, we analysed the relationships between preferred training topics and stakeholders’ characteristics and preferred types of training and stakeholders’ characteristics.

Again crosstabulations were made between challenges (barriers) for deployment and stakeholder related background variables were made. Chi-square tests of independence were then calculated to find statistically significant associations between the crosstabulated variables. Finally, Cramer’s V was calculated to find out the effect size. Again, the analysis was carried out for the data set including only fully completed responses provided to all language versions of the questionnaire (117 responses).

First, we studied the associations between the type of organisation and the selected training topics / tools. The following statistically significant relationships were found in the analysis:

- **Main areas of interest - Financing and funding opportunities <> Type of organisation (p = 0.049, Cramer’s V = 0.295)**
  
  In this case Cramer’s V suggests only a small effect.

- **Type of training - Participation in workshops/face-to-face trainings (organised by public authorities) <> Type of organisation (p < 0.001, Cramer’s V = 0.414)**

Looking at the detailed results one can see the for 25 out of 52 respondents (48%) of the public authorities voted for the topic “Financing and funding opportunities” as a main interest, whereas the interest of other stakeholder groups like the transport operators (30%) and the transport service
provider (20%) was much lower. For the secondly named relationship especially 87% Associations and ITS experts (13 out of 15) voted for workshops organized by public authorities, similar to 80% of the transport operators (8 out of 10). On the other hand only 4 out of 20 (20%) transport related service providers are interested in this type of training.

Second, we explored the associations between the regional level and the selected training topics / tools. The following statistically significant relationships were found in the analysis:

- **Main areas of interest - Financing and funding opportunities <=> Regional level** 
  \( p = 0.004, \)  
  Cramer’s V = 0.336
  In this case the results are highly significant according to the performed chi-square test! Cramer’s V suggests a moderate effect here.

- **Type of training - Participation in workshops/face-to-face trainings (organised by public authorities) <=> Regional level** 
  \( p = 0.005, \)  
  Cramer’s V = 0.332

A look at the detailed priorities showed that “Financing and funding opportunities” was selected as a main interest for training by 18 of 31 (58%) respondents working at local level, such as cities. According to the results, this topic seems to be more relevant on local level, than on regional or on international level. Regarding the workshop organized by public authorities, 20 out of 31 organisations (65%) working at local level are interested in this type of training, as well as 67% (28 out of 42) respondents from organisations active on national level. On the other hand, this type of training is less interesting for organisations working at regional level, as only 5 out of 18 (28%) preferred this type of training.

Third, we analysed the associations between the know-how level and the selected training topics / tools. The analysis did not provide any statistically significant results. In general, this leads to the assumption that either there is no association between the two variables, or that the small sample size does not allow revealing any statistically significant relationship. Only in one case the results should be considered for the further elaboration for the CAPITAL training programme. For the following relationship, the results almost meet the criteria for a statistical significance, and should be considered for further discussion, even if no statistically significant relationship could be identified.

- **Main areas of interest - General introduction on the topics <=> know-how level** 
  \( p=0.066, \)  
  Cramer’s V = 0.216

However, looking at the detailed results one can see that 11 out of 28 (39%) respondents that identified themselves as 1st level ITS starters indicated “General introduction to the topics” as main interest for training, but only 18% of the other levels. As a general introduction will be specifically target 1st level ITS starters this makes absolutely sense in this context.
Discussion of results on the results of the web-based questionnaire, conclusions and next steps

Considering the high number of invitations to the questionnaire that has been sent out, the response rate was relatively low. But it has to be considered that the questionnaire was quite long and the topic of ITS is quite specific (even if the questionnaire was formulated in a way to fit the needs of the 1st level respondents). Nevertheless, a response of 117 fully completed questionnaires was higher than originally expected and will enable to derive trends and needs of the different stakeholder groups.

Having a look at the general results of the web-based questionnaire it can be concluded that the main stakeholder groups targeted with the questionnaires were reached appropriately. To be more specific, a quite high number of cities, as one of the main targets of CAPITAL, answered the questionnaire, which increases the value of the results. Satisfactory geographical distribution was also achieved.

The results regarding priority topics were not that clear as expected. However, tendencies are noticeable. The statistical tests on correlation of different variables showed that there are statistical significant relationships between the know-how level of the respondents and some of the priority topics. Considering this for the further training programme specific training measures for the different ITS levels seem to be an appropriate solution. On the other hand, no statistically significant relations between the type of organisation or the regional level an organisation is working at and the priority topics could be identified. It also has to be considered that due to a too small sample size some additional significant relationships exist, but could not be proved due to available data. Some additional interesting priority topics were named by the respondents that should be taken into consideration for the further topic studies.

Differing from the priority topics, the barriers and challenges identified by the respondents were clearer, as the “unknown costs and benefits” of ITS systems and the “missing or unclear business models” were indicated as challenges by majority of the respondents. Especially, the first one is important for organisations that are active on national or even international level as the statistical analysis showed. On the other hand, organisations that work on regional or local level, like e.g. regions or cities, perceived the “lack of resource to further finance a further implementation of ITS” more important than organisations working at national or international level. The type of organisation showed no statistically significant relationship to the perceived challenges.

When looking at the main interests for training, all types of respondents wished for “best-practice cases” and training on “evaluation methods and cost-benefit analysis”. “Financing and funding opportunities” were ranked lower on aggregated level, but are important topics for public authorities, or organisations working at local level.

Last but not least, the analysis of the preferred training tools (preferred type of training) showed that the respondents are in favour of webinars to very specific topics and participation in workshops organised by public authorities. Online courses are ranked on the 4th place. It’s interesting to see
that especially the respondents that identified themselves as associations or ITS experts are clearly in favour of the workshops organised by public authorities. This type of workshop is also one of the two most favoured types of trainings of public authorities (next to online courses).

The results as summarised before will enable further conclusions, especially when comparing the results to the other activities performed, and building a valid basis for the final conclusions and recommendations for further elaboration of the training programme.

The same main topics (priority topics, barriers and challenges, main interests for training and preferred training tools) will be analysed in the next subchapter. Following this, chapter 2.2.6 will compare the results of the different activities to each other. As mentioned before, one has to consider that the results of the web-based questionnaire are the core results. Nevertheless, these additional sources will give an opportunity to better understand the results of the web-based questionnaire and to have deeper look at the needs of the different stakeholder groups.
2.2.2. **Analysis of the results of the in-depth interviews**

**General introduction to the interviews**

The expert interviews, as described in the previous chapter, were carried out in May and June 2017. In total, 9 interviews were carried out with interviewees from the targeted stakeholder groups. An overview of the interviews is provided in the following table:

<table>
<thead>
<tr>
<th>Interviewee</th>
<th>Interviewer(s)</th>
<th>Stakeholder group</th>
<th>Time and Place</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dennis Macke, Advisor Economics and Martin Elferink, Traffic expert, City of Emmen</td>
<td>Tamara Goldsteen</td>
<td>City (1st level)</td>
<td>22 June 2017, 11:00-12:00</td>
</tr>
<tr>
<td>Leon van den Biggelaar, City of Eindhoven</td>
<td>Gert Blom City of Helmond</td>
<td>City (2nd level)</td>
<td>n.a.</td>
</tr>
<tr>
<td>Bahar Namaki Araghi; ITS Project Manager; City of Copenhagen</td>
<td>Gert Blom and Tamara Goldsteen; City of Helmond</td>
<td>City (3rd level/ITS frontrunner)</td>
<td>20 June 2017, 4 pm</td>
</tr>
<tr>
<td>Darren Capes, Transport Systems Manager, City of York Council, Transport Services, Directorate of Economy and Place</td>
<td>Katharina Zwick, AustriaTech</td>
<td>City (3rd level)</td>
<td>telephone call Monday, 2017/06/20, 11:00-11:45 (Europe Summer Time, GMT+02:00) –&gt; 11:00-11:31</td>
</tr>
<tr>
<td>Olli Pihlajamäki (Head of Logistics), Lassila &amp; Tikanoja Oy</td>
<td>Fanny Malin &amp; Henri Sintonen, VTT</td>
<td>Fleet Operator</td>
<td>Thursday, 2017/06/22, 13:00-14:00 (EET). Lassila &amp; Tikanoja Headquarters (Valimotie 27, 00380 Helsinki, FIN).</td>
</tr>
<tr>
<td>Mihai Niculescu, Politehnica University of Timișoara (RO) (as well as president of ITS Romania and employee of ELSOL)</td>
<td>Katharina Zwick, AustriaTech</td>
<td>Knowledge provider: research institution/university</td>
<td>WebEx Call, Tuesday, 2017/06/06, 15:00-15:45 (Europe Summer Time, GMT+02:00)</td>
</tr>
<tr>
<td>Prof. Dr. Constantinos Antoniou, Technical University of Munich</td>
<td>Panos Iordanopoulos, CERTH</td>
<td>Knowledge provider: university</td>
<td>Skype Call, Friday, 2017/06/09, 12:00-12:30 (Europe Summer Time, GMT+02:00)</td>
</tr>
<tr>
<td>Politecnico di Torino</td>
<td></td>
<td>Knowledge provider: university</td>
<td>19 June 2017</td>
</tr>
<tr>
<td>Kimmo Ylisiurunen (KY), Managing Director, Infotripla Oy</td>
<td>Fanny Malin, VTT</td>
<td>Data and service provider</td>
<td>Wednesday, 2017/06/28, 10:00-10:30 (EET). Skype Online Meeting.</td>
</tr>
</tbody>
</table>

Table 2: Overview of interviews
Due to the low number of interviews the results are not statistically relevant, but the give deeper insight on the views of the stakeholder groups, can explain underlying expectations and motivations. The results can be compared to the results of the web-based questionnaire and self-assessment, and they will complement the picture on stakeholders’ training needs.

For the interview analysis, it is important to point out that the codes “CODE03/07 Other training interests”, “CODE02/09 Other/Barriers” and “CODE01/02 Additional High Priority topics” have a very high share within their categories. This is because of the fact that in face-to-face and telephone interviews with open questions interviewees told a lot of additional information coming out of their experience.

**High priority topics**
The priority topics were analysed similar to the categories of the web-based questionnaire, as one can see from the following *Figure 16: Overview of priority topics* stated in the interviews.

Regarding the priority topics, the interview partners had a clear tendency: 5 out of 9 respondents see the topic of traffic management and network control as highest priority in their sphere of influence. Subtopics that were mentioned in this respect were traffic control especially considering the optimisation of traffic flows in the urban area, but also on the high level road network. Furthermore the relation to the smart city concept (including next to traffic management also smart parking, ticketing, etc.) was mentioned as high priority in the interviews.

**C-ITS was the second most frequently stated priority topic in the interviews.** According to the interviews, this topic is highly connected to the first-ranked traffic management, as congestion in the urban areas and on the main roads without the possibility to build new roads requires innovative solutions. These solutions are expected from C-ITS.
The respondents also added some additional high priority topics that were not covered by the list of topics so far. Especially, the interviewees from cities added topics in relation to the policy goals like road safety and healthy, vital and growing urban areas. Research institutions, on the other hand, added additional aspects regarding the knowledge on and the design of transport systems, as well as the consideration of human factors regarding the adoption of various systems. In addition, user acceptance and possibilities to reach more users were also mentioned as high priority topics.

**Barriers for (C-)ITS deployment**

The barriers for ITS perceived by the respondents are not that clear. Considering the categories also included in the web-based questionnaire it can be stated that diverse barriers exist, but no main challenge could be identified. As presented in the next figure interviewees mentioned the fact of complex procurement, as well as the topic of unknown cost-benefit of the ITS systems, but also the missing of ITS related topics on the Agenda of politicians are each mentioned in 2 of 9 interviews.
As already explained in the introduction to the interviews, other additional barriers, that have not been included in the list of barriers so far, were highly relevant for the respondents (as it can be seen in Figure 18):

- **Policy barriers including lack of coordination and cooperation**: Interview partners mentioned here a lack of coordination on policy level, between different decision makers, but also between stakeholders from the public and private sector. Missing common roadmaps and action plans, especially in the area of C-ITS, hamper the further (harmonised) deployment of (C-)ITS services and development of national or European wide solutions. According to the interview partners, the missing coordination and cooperation on the policy level or between relevant ITS stakeholders is an obvious challenge that should be tackled in order to foster a more rapid and harmonised deployment of ITS. This barrier was mentioned not only by the public authorities, but furthermore interviewees from the research institutions.

- **Missing standards (in the area of C-ITS)**: Especially in the area of C-ITS, international standards are missing. But not only from the technical point of view. It’s rather a question of having guidance on how to address problems from the public authorities’ point of view. Also this barrier is linked to the aforementioned lack of coordination and cooperation on policy level.

- **Missing visibility of the benefits of ITS**: Public authorities, as well as research institutions mentioned the aspect that the benefits of ITS are often not clear to the potential users or investors. In many cases, the raising of awareness and understanding for ITS and the related
benefits is a resource-intensive and long process. Some of the respondents have experienced the situation that it’s difficult to make e.g. public authorities understand, why an investment in ITS is necessary and useful.

When looking at the barriers, no clear differences could be identified between respondents from the different stakeholder groups.

**Main interests for training**

Regarding the main interests for training, 5 out of 9 interview partners were interested in best-practice cases which were directly followed by evaluation methods and cost-benefits analysis of (C-)ITS services. The best-practice cases would include best-practice catalogues, but mostly lessons learned from other organisations of the same stakeholder group (e.g. cities). Interview partners mentioned the need for examples of deployment or implementation models, the challenges for this deployment, but also the benefits that could be identified afterwards. The topic of best-practices was mentioned by all stakeholder groups covered by the interviews. Furthermore, one interview partner explained that a good overview of showcases is missing.

Regarding the evaluation methods and cost-benefit analysis, the interview partners included e.g. the measurement of the impact of C-ITS services, but also the benefits of ITS on the ecosystem, as well as the calculation of costs, including also maintenance costs and related indirect costs (as additional need for road works, communication costs, etc.) as a main interest for training.

![Figure 18: Distribution of perceived barriers for implementation of (C-)ITS incl. other](image-url)
4 interviewees identified “other training interests”. These interests were very diverse, and no specific training interest did come up more often than others. What has been mentioned, is the interest in having an overview of international developments and information about international research and studies in particular. One interviewee wished to have information on the acceptance and visibility of ITS in the training programme. Another interviewee highlighted that policy and strategy frameworks could be of interest for the training participants. In addition, it was highlighted that training on models for cooperation between stakeholders would be interesting. This is consistent with fact that this topic was also pointed out as barrier (lack of cooperation between the stakeholders – policy barrier).

**Preferred training tools**

The preferred training tools are an important aspect for CAPITAL. Next to the online courses it will be necessary to assess priorities and motivations for the different types of trainings. What the results showed is the need for a combination of easy to access and flexible online training possibilities (including online courses, but as well as webinars to specific topics) on the one hand and possibilities to have face-to-face trainings on the other hand. The analysis of the interviews showed that online courses and online training modules, as well as interactive webinars with a smaller group of people, are a cost-effective and easy opportunity to
participate in different types of trainings. These type of trainings seem adequate for showing best-practice examples, available ITS options, but as well providing very basic information on ITS. One of the interview partners pointed out that IT based trainings could be challenging for persons that are less experienced with IT technologies.

On the other hand, the respondents defined personal or face-to-face training as important training tool for CAPITAL. For most of the respondents, this was understood as local workshops or workshops with local participants, specifically dedicated to the needs of the participants in the region or geographical area. These workshops are an important tool for interaction between the trainers and trainees and face-to-face exchange of information and experiences. Furthermore, a network can be established. Within that network the awareness for the existing problems can be raised and possible solutions can be discussed in the exchange with others with the same background. In the area of fleet management, face-to-face trainings are normally used with completely new processes and equipment.

The respondents formulated also additional recommendations for the elaboration of training programmes:

- The training should be very practical or hands-on training appropriate for people who are working in the area of ITS or who will be involved in the deployment of ITS (e.g. including on-site visits).
- Training material is great, but if received by e-mail this could be easily overlooked.
- Single introductory seminars were considered as a good option for CAPITAL.
The interviewees were also asked to assess the idea of the peer-to-peer learning concept. In principle, 6 out of 9 respondents agreed to the concept of peer-to-peer training. Some of the interview partners mentioned in addition the positive aspects of a peer-to-peer training, e.g. “having people with similar experience and working field to share their expertise”. Furthermore, the aspect of trust and transparency has been mentioned (“cities trust other cities”; “information from suppliers is not transparent”). One respondent considered also the option of combining the peer-to-peer approach with training from universities/research institutions on very specific technical issues. Nevertheless, 4 out of 7 interview partners also commented on the negative aspects of the concepts, e.g. the lacking enthusiasm of persons to participate as trainers (2x), the high need for organisation and working time, as well as a potential lack of skills as trainers. One interview partner also mentioned that training is not a task of public authorities.

**Assessment of the “trainee” group**

One additional aspect was included in the interview guideline that is completely different from the web-based questionnaire: Interview partners were asked which groups or stakeholders need to be trained from their point of view. The answers were relatively clear:
In 7 out of 9 interviews respondents named the public sector as main target group for CAPITAL training activities (including different groups of public authorities like authorities, administrations, etc). Next to this main group of public authorities transport operators (especially public transport service operators) were named as another relevant trainee group by 3 interview partners. Other groups that were mentioned as potential trainees for CAPITAL were e.g. the general public and the police.

**Additional relevant aspects**

The respondents coming from universities or research institutions were asked on the potential role of universities in relation to CAPITAL and vice versa, but also on the training activities focusing on ITS. The answers can be summarized as follows:

- University training and courses are targeted to students and people with scientific background. CAPITAL should focus on a broader audience.
- The cooperation between universities, industry and the public sector is important for understanding the different views and getting a broader picture.
- There is a clear role for the universities regarding the qualification for ITS.
- In addition to students it is necessary to train also persons already working in the area of ITS.
- Different short courses and trainings (e.g. as part of ITS EDUNET) already exist and should be considered in the elaboration of the CAPITAL training programme.
2.2.3. Analysis of the results of self-assessment

General remarks on the self-assessment
For the self-assessment, the expertise of the consortium is summarised in the following text and figures which will provide a comprehensive picture of the consortium’s available know-how. The main focus of this analysis is on the expected training needs. The results of the self-assessment were analysed with the qualitative content analysis method [add reference] like the results of the interviews. The categories used for the coding were the same as for the interviews and used in the web-based questionnaire. FIA and ERTICO were excluded from the self-assessment, and they are not considered in this analysis.

Priority topics according to the consortium’s self-assessment
The consortium was quite clear on what are the high priority topics for CAPITAL, as it can be seen in Figure 22: Distribution of priority topics according to self-assessment.

![Distribution of Priority Topics (No of Cases)](image)

Figure 22: Distribution of priority topics according to self-assessment

The clear main priority for CAPITAL from the view of the consortium partners is C-ITS, including the variety of aspects related to the topic (in urban area, on the secondary road network, traffic modelling including C-ITS, awareness of C-ITS applications, integration of C-ITS services with other
services, framework, use cases, C-ITS and automated driving, data requirements for C-ITS, specific technical issues like communications, etc.). Furthermore, access and management of data is also a relevant topic within the consortium. In addition, the consortium mentioned topics like automatisation, privacy and data security issues.

**Main interests for training according to self-assessment**

Based on the answers to the self-assessment, it was possible to identify the main interests for training in the consortium. The consortium had a clear interest in evaluation methods, cost-benefit analysis of (C-)ITS services, the use of KPIs and impact assessment, as shown in Figure 23: Identified interest for training from the self-assessment.

![Figure 23: Identified interest for training from the self-assessment](image)

Furthermore, the “Development and implementation of national ITS Action Plans and deployment roadmaps” as well as “Development of an ITS frame architecture on national level” came up as additional topics in the self-assessment.

**Assessment of the trainee group according to the self-assessment**

Besides priority topics and main interests for training the consortium narrowed the stakeholder group that should be in the focus of the training activities. This assessment is already reflected in the definition of the main trainee groups in deliverable D.2.1.
In the self-assessment, most partners defined public authorities as a clear target group for training. To put it more precisely, the consortium defined local authorities (regions and municipalities) as main trainee target group, as well as ministries. Especially, the ITS starters (1st level) should be in the focus of the training.

On specific technical or national issues, relevant national ITS stakeholders are seen as potential participants of the CAPITAL training. Due to its specific focus, IRU defined drivers and fleet owners as CAPITAL target group.

**CAPITAL consortium’s expertise**

As already mentioned before, the consortium summarised their main expertise that can be contributed to the training.

On the aggregated level, the consortium can provide expertise on a wide variety of ITS topics. The specific expertise of CAPITAL consortium was aggregated to more general clusters:

- **ITS policy expertise:** The consortium has vast experience in the area of mobility policy and ITS policy development. The CAPITAL consortium is suitable to provide an overview on the current ITS priorities, as well as on the different national or European legal frameworks for ITS. The consortium is experienced in developing Action Plans, Roadmaps and Guidelines for ITS implementation and in formulating and designing other types of ITS strategies. Furthermore, partners have already been involved in development of technical specifications and standards.

- **Test and deployment of ITS:** The CAPITAL consortium can provide expertise on the planning and implementation of tests and demonstrations, pilots, living labs and also large scale trials. The partners are experienced in the evaluation of the technical performance, but furthermore can bring in experience on turning pilots into operations.

- **Evaluation and impact assessment** of ITS services: CAPITAL partners can provide expertise on the assessment of different ITS services and applications, as well as on user assessment. The partners have experience in cost-benefit analysis of ITS and C-ITS systems and services, as well as on the promotion of the added-value of ITS technologies.

- **Stakeholder involvement:** CAPITAL partners have long-standing experience in the involvement and integration of the relevant ITS stakeholders (e.g. different local stakeholders, public authorities, etc.) and setting up ITS platforms and communities.

Besides the aforementioned bullet points, it has to be considered that the CAPITAL partners can provide different local perspectives and have the possibility to provide or organise visits to local facilities or implemented ITS services. Furthermore, some of the partners have academic experience than could have a positive impact on the development of the training programme.
2.2.4. **Analysis of data from additional input sources (Special Interest Session)**

As foreseen in the project proposal, CAPITAL planned to have at first a meeting of public authorities assessing barriers for (C-)ITS deployment and the specific needs of the public authorities for training. In agreement with the project officer, the CAPITAL consortium decided to organise a Special Interest Session at the ITS Europe Congress in Strasbourg to collect input from the stakeholders and to provide an open the space for a discussion between and with the public authorities.

**Setting and content of the session**

The Special Interest Session took place in Strasbourg during the ITS European Congress on the 21st of June 2017 (SIS32 – (C-)ITS for public authorities: challenges and barriers to deployment – from West to East and it is scheduled on Wednesday 21 June 2017, 11:00 – 12:30). DG MOVE moderated the sessions and five speakers covered the East and West areas of Europe, focusing on the following content as it can be seen from the conference programme:

“(C-)ITS for public authorities: challenges and barriers to deployment – from West to East

Finding best solutions for deploying C-ITS services is the focus of several European co-funded initiatives. The EC has created the C-ITS platform bringing together private and public stakeholders. The latter are increasingly invited to know further and be pushed in the use of C-ITS solutions. However, not always have the necessary resources and differences are remarkable. For instance, Western European countries are forerunners in C-ITS deployment while in Eastern Europe ITS deployment issues are diverse and C-ITS is less relevant. Thus, it is of primary importance to raise awareness through initiatives that focus on education such as the EU project CAPITAL while on parallel make a detailed comparison of stakeholder needs from West to East, barriers and challenges in (C-)ITS deployment and look at existing initiatives to overcome these. Many public authorities are involved in CEF projects such as CROCODILE 2 focussing on ITS deployment on Eastern Europe’s corridors for overcoming challenges.”

The session was moderated by **Pedro Barradas from the European Commission**.

The first speaker, **Gert Blom from the City of Helmond**, summarized the current main challenges in C-ITS deployment in the Netherlands. He pointed out that there is a high need for cities like Helmond to optimize the existing infrastructure using technology driven urban traffic solutions. Prior projects (such as FREILOT) have shown the effectiveness of ITS solutions for reducing fuel consumption and emissions by speed and time-to-green advice given to the users. In parallel, the traffic flow could be optimized with more fluent traffic and less congestion. This is the reason point why the deployment of C-ITS will be crucial for cities in the near future. Moreover, learning on ITS solutions is always **learning by doing, but also doing by learning**! Projects like CAPITAL can support ITS stakeholders in getting started by showing examples and giving basic guidance, but the community will also benefit from sharing the learnings that come from the real implementation (Blom 2017)

**Graham Hanson from the Department for Transport in the UK** reported on the current British C-ITS trials. Graham also gave an insight on the needs of public authorities with C-ITS: Before implementing, a local authority needs to consider the benefits of an investment (who receives it, how widespread is it, how it is valued, how robust is the estimation), as well as the policy objective and context. But especially for the benefits, not much is proven yet. To capture evidence on the benefits, a research programme has been created that addresses the barriers in the C-ITS dealing with urban C-ITS, SPAT MAP, UTMC/SCOOT development, Connected Parking and Procurement. In
parallel, the outcome will be monitored against a common evaluation framework. For the DfT, learning by doing is the most important approach, and trials and the real deployment are therefore the core activities. Learning from others is also important as well as investing in different levels of know-how and building a community of interest to bring together stakeholders with similar problems or similar interests (Hanson 2017).

Martin Böhm from AustriaTech, coordinator of CROCODILE2 and involved in the C-Roads platform, pointed out the need for cooperation and collaboration, especially cross-border collaboration in Central-South-East-Europe, as especially for Central-South-East European countries learning and know-how gathering have high importance. Decision makers need to learn where they have to start when it comes to the deployment of (C-)ITS. He emphasized that “neutral” know-how exchange between public authorities is important. And a trustful relationship and environment is the most important basis for fruitful collaboration, but this needs time to grow. In this regard, he pointed out the need for learning tools that are based on personal interaction and contact to build a network (Böhm 2017).

Martin Pichl from the Ministry of Transport of the Czech Republic summarized the main challenges they faced in the deployment of C-ITS. He mentioned e.g. the challenge of transferring R&D results into real operations, the interfaces between vehicle and road infrastructure, the harmonisation of service, cross-border and international activities, but furthermore the cooperation between transport and telecommunication sector. He also highlighted some limitations for the C-ITS deployment e.g. the missing business model for C-ITS, the necessary educational and training programmes for drivers and the need for public awareness about C-ITS. He pointed out that the cooperation with technical partners, as well as projects with industry, are highly important to foster the further deployment of C-ITS in the Czech Republic. The aim is not to be follower, but instead to ensure that the next generation of C-ITS services is available for the users to really increase safety and to make the impacts for the Czech public tangible (Pichl 2017).

Mihai Niculescu from ITS Romania reported on the current deployment of (C-)ITS in Europe, provided an overview on the relevant decision makers involved and the national legal framework for ITS deployment. The priorities for Romania are at the moment the deployment of ITS infrastructure and TM/TIS services on existing and new motorways, smart urban mobility and the regional and European harmonisation of the ITS services. C-ITS are at the beginning but other topics are more relevant at the moment, as ITS is in an early stage of implementation. He highlighted also the need for the cooperation between the different involved stakeholders, on national level, but also on international level (Niculescu 2017).

Guido Di Pasquale from the Research and Innovation unit of UITP, emphasized the current need of integration in the area of public transport: integration on institutional level, information integration, integration of ticketing, integrated mobility platforms, etc. Furthermore, he highlighted the role of standardisation and stated that suppliers as well as cities perceive the lack of standards as an important technical barrier to urban C-ITS deployment. In order to provide high quality service in the area of public transport, well-trained staff is necessary. That’s why UITP developed a portfolio of training programmes that can play an important role for the further development and provision of innovative services (Di Pasquale 2017).
Main outcomes
The main focus was to gain a deeper insight especially on the needs of public authorities and the barriers they perceive regarding the deployment of C-ITS that differ between Western Europe and the Central and Eastern European countries. But most important was to gain insight on the needs regarding training in the area of (C-)ITS. The speakers were quite clear on this issue:

- Learning by doing: It is important to start deploying ITS and to learn directly from doing and then share your experiences with others.
- Build a community of interest: Bring together those stakeholders that share needs and interests.
- Cooperation is the key: Cooperation on different levels is crucial for the deployment of C-ITS, but one of the trickiest tasks. Collaboration and cooperation is not only the most important basis for ITS deployment but a crucial key for learning.
- Build on trust: Cooperation based on trust is the key for successful collaboration and mutual learning.

In addition to the topic of learning some main outcomes should be summarized as it follows:

- C-ITS is a highly relevant priority as far as other more basic ITS implementation topics are solved.
- There is a need for evidence of the impacts of (C-)ITS but also the need for clearer business models.
- Integration and standardization play an important role in the deployment of C-ITS. If missing, they could represent a major barrier for deployment.
2.2.5. Analysis of needs of professional end-users

The professional end-users in the definition of the CAPITAL project (see deliverable 2.1.) are the “end-users” that can be reached by the platform e.g. truck drivers. As already mentioned, the needs of professional end-users were assessed by IRU with a brief literature study. IRU Projects and IRU Academy have received requests from members to investigate needs and investigate what are the training capabilities for the drivers across Europe. As a starting point current studies and reports on road safety were taken into consideration in the literature study:

- The Global Status Report on Road Safety 2015
- IRU Scientific Study “ETAC” European Truck Accident Causation (2007)
- FMCSA (Federal Motor Carrier Safety Administration) study on Large Truck Crash Causation (2006)
- The European Accident Research and Safety Report 2013
- EC proposal to revise the General Safety and Pedestrian Safety Regulations (2016) (Giannini, Marmy 2017)

The results were presented and discussed at the ITS Europe Congress in Strasbourg at 20th of June 2017 (PR01 – Training needs on new technologies for fleet managers and drivers) by Monica Giannini from IRU, and they are the basis for the following summary of results. Furthermore, the experiences of UNTRR (National Union of Road Hauliers from Romania) presented at the same session (by Roxana Ilie, UNTRR) regarding the training needs for truck drivers were also considered for the summary of needs.

Main results on the training needs for truck drivers

- Training and training programmes on ADAS are urgently required, especially focused on the effective usage of ADAS. The training is required for drivers, as well as for operators. Current learning programmes do not cover this issue appropriately (Giannini, Marmy 2017)
- The training need for ADAS is also caused by the huge variety of functions that are available for support of the drivers (e.g. Pedestrian Detection System, Curve Speed Warning, Accident emergency call system or eCall, Driver Monitoring Systems, Lane Departure Warning, Road Sign Recognition, Surround View Cameras, Adaptive Cruise Control, etc.). Specific training could support the driver in activating and use the available functions of their on-board units correctly and can furthermore raise the awareness of the drivers for the potential of the system. On the meta level, safe and efficient use of the trucks could be fostered (Giannini, Marmy 2017; Ilie 2017).
- It has been shown that trucks are not used at the moment to the full capacity as drivers often disable technologies if the usage is too complicated, the benefits of the function is unclear or the technology is not perceived as helpful. In other cases the full capacity cannot be reached as the drivers do not use the technology correctly (Ilie 2017).
- The focus of a training programme should be on “how drivers interact with and use ADAS” (Giannini, Marmy 2017).
- Currently, drivers and operators need to rely on the operational manuals of the manufacturer as information source for the training (Giannini, Marmy 2017)
- Training is needed also for the correct operation of enforcement tools like the digital tachograph (smart tachograph) and the on-board units for electronic tolling. On the one hand, there is a need for compliance with the European regulations, and on the other hand, a need to avoid fines.

- Training for transport operators on fleet management systems is needed in order to optimize the usage of fleet management systems and subsequently raising the competitiveness of the company. Furthermore, effective management of fleets contributes to the reduction of emissions.

- According to the input of UNTRR, there is a need for European wide qualification programme to provide professional education and technical skills for professional drivers, especially focused on persons that are beginners in the job. Such European initiative could furthermore address the current driver shortage in the sector by providing a substantial vocational programme, specifically focused to young persons.

- The rapid development of new technologies leads to new training needs in order to make use of the available technologies and to increase efficiency and competitiveness. Considering this, specific training on new technologies and innovations in the truck for professional drivers will gain more and more relevance.
  (Ilie 2017).

The outcomes of the literature study are quite clear and provide relevant input for the next steps. The next step will be the review of specific driver training programmes to identify the current gaps and developing specific training measures. The training itself will be conducted outside CAPITAL, as it will be combined with the IRU training academy’s activities.
2.2.6. **Comparison of results**

As already stated before, this chapter compares the results on the main topics such as priority topics, barriers and challenges, main interests for training and preferred training tools. It has to be considered that the results of the web-based questionnaire are the core results, as the questionnaire covered a larger and more representative group of respondents than the stakeholders which participated in interviews or self-assessment. However, these additional sources will enable a better understanding and a cross-check of the results of the web-based questionnaire. Furthermore the additional activities will provide the opportunity to have a deeper look at the needs of the different stakeholder groups.

**Comparison of priority topics**

For the comparison of priority topics, an additional step is necessary. For the self-assessment and the interviews the topics were aggregated to the main topic area (e.g. traffic management and network control, C-ITS, Access and Management of Data). In this following explanation topic areas are the areas of ITS where the subtopics, that could be picked as priority topics in the questionnaire, are included (see therefore chapter 2.2.1).

In order to compare the topic areas, which were coded in the interviews and self-assessment of needs the preferred subtopics from the analysis of the web-based questionnaire had to be summed up (as each of the subtopics belongs to one of the main topics):

The three topic areas identified based on the results of web-based questionnaire, with the highest relevance for 2nd and 3rd level respondents, are event detection and transport data collection (which belong to the main topic Access and Management of Data), followed by safety and security for passenger transport (Passenger Transport Services) and multimodal journey planning (Traveller Information Services).

For the 1st level respondents, traffic control in urban areas (assigned to the main topic Traffic Management and Network control) is the most important topic, followed by access to dynamic transport data (Access and Management of Data) and followed by Integrated Traffic Management (Traffic Management and Network Control) and C-ITS in urban areas (Emerging Services – C-ITS) with the same ranking.

Summarizing the identified topic areas according to the results of the web-based questionnaire are:

- Access and Management of Data
- Traffic Management and Network Control
- Passenger Transport Services
- C-ITS

The main topic areas with the highest priorities (priority topics) according to the interviews are:

- Traffic Management and Network Control
- C-ITS
- Passenger Transport Services
- Traveller Information Services
According to the results of the self-assessment, the main priority topics for training are:

- C-ITS
- Traffic Management
- Access and Management of Data

The interviews supported the results obtained with the web-based questionnaire. We can see that the self-assessment is more focused on the topic of C-ITS, as this is also the main focus of the project, but also included the two main priorities identified that match the results of the web-based questionnaire.

Considering the input given in the Special Interest Session, it can be stated that C-ITS has a high relevance for the involved stakeholders, especially in Western and Central Europe. For countries that are ITS followers, C-ITS is not that important, as they focus at the moment on services in the area of Traffic Management and Traveller Information Services.

All in all, the main priority topics identified are similar in all activities performed.

**Comparison of barriers and challenges for ITS deployment**

Comparing the results regarding the perceived challenges for ITS deployment the results are quite clear for the respondents of the web-based questionnaire: 60% (53 out of the 89 respondents) perceive that when the “cost and benefits of such a system are not known” this is a major challenge that could hinder the further deployment of the respective ITS application/system. This challenge is followed by “best organisational structure/business model for such a system is not clear” and “lack of resources to finance further implementation”, that were voted by 46% (41 out of 117) and 43% (38 out of 117) of the respondents respectively.

For the interviews the results were not so clear. Challenges regarding the complexity of procurement, as well as lack of information on costs and benefits of the ITS systems, but also the absence of ITS related topics on the Agenda of politicians were the three main mentioned barriers. Moreover, it has to be considered that the interview partners named a number of additional challenges, that were not fully covered by the barriers formulated in the web-based questionnaire. Additional policy barriers, especially the lack of coordination and cooperation was one of the main barriers mentioned by the interviewees, directly followed by the lack of clear standards and guidance and lack of the visibility of the benefits of ITS.

This result is in line with the results of the web-based questionnaire. The need for cooperation and the challenge of the multi-stakeholder involvement was also mentioned a few times by the respondents of the web-based questionnaire. Also the challenge regarding the unknown costs and benefits of ITS systems was mentioned by the respondents of the web-based questionnaire.

Taking into account the main outcomes of the Special Interest Session, the involvement of the different stakeholder groups and a lack of cooperation were also perceived as a challenge by the speakers of the session.
What can be seen from the comparison is, that there is a clear need for training regarding cost and benefit analysis of ITS services, but also to communicate the benefits and costs of the different ITS services for the different stakeholder groups. Furthermore, there is a need for more cooperation and coordination in the ITS sector. Besides that, business models are not clear for several ITS and C-ITS services, and many organisations lack of the necessary budget to finance innovative solutions.

**Comparison of main interests for training and preferred training tools**

The main interests for training are clear and comparable:

In respect to the web-based questionnaire, 63% of respondents (74 out of 117) were interested in “best-practice cases” followed by “evaluation methods and cost benefit analysis of ITS services” which is preferred by 57% (67 out of 117), “Relevant technologies and standards”, ranks third with 52% (61 out of 117). This is similar to the main interests named by the interview partners with best-practice cases directly followed by evaluation methods and cost-benefits analysis of (C-)ITS services. Also the consortium sees a need for this training as evaluation methods, cost-benefit analysis of (C-)ITS services, the use of KPIs and impact assessment were named most frequently by the consortium partners.

Regarding the main training tools, 56% of the respondents (66 out of 117) of the web-based questionnaire were interested in receiving training in the form of “participation in webinars to very specific topics”, followed by “participation in workshops / face-to-face trainings (organised by public authorities)” which was preferred by 53% of respondents (62 out of 117). “participation in workshops/ face-to-face trainings (organised by industry)” was preferred by 52% of respondents (61 out of 117). The interviews showed, on the other hand, that there is a need for a combination of easy to access and flexible online training possibilities (including online courses, but as well as webinars to specific topics) on the one hand and possibilities to have face-to-face trainings on the other hand, which is in line with the results of the web-based questionnaire.

On a general level, it can be concluded that the results of the different activities are meshing and complete the picture on the training needs.
2.3. Conclusions and summary of capacity needs for the different stakeholder groups

Based on the results presented in the last sub-chapter, the outcomes of the study are aggregated in this chapter for the different stakeholder groups. As mentioned in chapter 1 and in the introduction to chapter 2, the main group of trainees are predominantly public authorities, followed by transport operators and fleet owners and professional end-users. Suppliers and knowledge providers will be involved for exchange and knowledge transfer between the groups but will not be trained themselves in the framework of CAPITAL. Aligned to this, the different tools were mainly focused on the group of public authorities, transport operators and fleet owners. The needs of these groups are summarized below.

2.3.1. General conclusions

As expected, the results of the additional activities (e.g. interviews, self-assessment) complemented the needs assessment that was mainly derived from the web-based questionnaire.

All three know-how levels were covered by the activities.

When having a deeper look in the main target group of public authorities, one can see that most respondents (50%) categorized as public authorities are cities or municipalities (26 out of 117). Therefore, it can be stated that the targeted stakeholder group was appropriately reached by the questionnaire. Also the different regional levels the public authorities were working at (local authorities like cities, regional authorities, national authorities or international authorities), as well as all know-how levels (1st, 2nd and 3rd level) could be covered.

A wide variety of 23 different countries were covered by the questionnaire including Albania, Austria, Belgium, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Italy, Nigeria, Qatar, Romania, Slovenia, Spain, Sweden, the Netherlands, Turkey, and United Kingdom. As expected, the responses were not distributed equally. Major input was coming from Great Britain, Greece, Finland, the Netherlands, Austria and Italy. This has to be considered when interpreting the outcomes. Nevertheless, the wide scope of the regional coverage enables a derivation of recommendations.

The results of the web-based questionnaire are the core results of the analysis. The number of responses enables (at least partly) statistically significant results and is suitable for deriving a tendency for the priorities and needs of a cross section of the relevant ITS community. The results of other activities (interviews, self-assessment, etc.) are important for comparing the results and to gain a better understanding on the needs of the different stakeholder groups.

Main priority topics were successfully identified based on the questionnaire, interviews and self-assessment.
The main priority topics on a general level are (without ranking, in alphabetical order):

- Access and Management of Data
- C-ITS
- Passenger Transport Services
- Traffic Management and Network Control
- Traveller Information Services

Considering the highest priority regarding the subtopics (as a result only of the web-based questionnaire), the following are the top ranks for the 1st level and 2nd /3rd level:

- traffic control in urban areas (Traffic Management and Network Control)
- event detection and transport data collection (Access and Management of Data)

On the second rank there are:

- access to dynamic transport data (Access and Management of Data) for 1st level respondents
- safety and security for passenger transport (Passenger Transport Services) for 2nd /3rd level respondents

Topics on the third rank include:

- access to dynamic transport data (Access and Management of Data) and and C-ITS in urban areas (Emerging Services – C-ITS) for the 1st level
- multimodal journey planning (Traveller Information Services) for the 2nd /3rd level

The results of the questionnaire indicated that there is a difference between the different ITS know-how levels in relation to the priority topics.

The chi-square tests of independence calculated for stakeholder related background variables (organisation type, regional level, know-how level) and the priority topics showed that there a statistically significant difference in the priority of some topics between the different ITS know-how levels. **Considering this fact, it is important to elaborate training programmes with different topic priorities that are specifically targeting the different know-how levels.**

This could mean that training programmes for e.g. 3rd level ITS experts will focus on “Event detection and transport data collection”, “C-ITS on high level road network”, “Aggregation and Management of transport data” or “Access to dynamic transport data”, whereas training programmes for 1st level respondents will cover “traffic control in urban areas”, “access to dynamic transport data”, “Integrated Traffic Management” and “C-ITS in urban areas”. Programmes for 2nd level ITS practitioners could cover, according to the results of the web-based questionnaire, event detection and transport data collection, safety and security for passenger transport and multimodal journey planning.

On the other hand, organisation type was not found to have a statistically significant association with the priority of different topics. This result suggests that, the main topics of the training programmes do not need to be different for the different stakeholder groups.
The interviews also yielded a number of additional topics which may be considered in further development of the CAPITAL training programme, including:

- Connected and autonomous vehicles or connected autonomous driving, incl. truck platooning
- Road Safety
- Electromobility
- User acceptance
- ....

According to the study results, the main self-reported barriers or challenges for ITS are:

- Unclear costs and benefits of ITS services, also including a lack of awareness on the benefits of ITS systems in general
- Lack of cooperation and coordination in the ITS sector, also caused by the factor of the complexity of the multi-stakeholder involvement
- Missing or unclear business models for ITS
- Need for financial resources for the implementation of ITS

The perceived barriers are at least partly different in case of organisations working on different regional levels (local, regional, national, international). For example, the barrier regarding the lack of financial resources is especially true for the regional or local level.

Stakeholders’ main interests for training are:

- Best-practice cases
- Evaluation methods and cost-benefit analysis of ITS services

The study results indicated that there are statistically significant differences in the main interests for training between stakeholders working on different regional levels and in the main interests for training between different organisation types. For example, “financing and funding opportunities” had high importance public authorities as well as organisations working on the local level but not for other stakeholder groups.

The preferred training tools seem to be a combination of easy to access and flexible online training possibilities and face-to-face training possibilities. The results of the web-based questionnaire showed a preference towards webinars to very specific topics, as well as face-to-face workshops either by public authorities or by industry. The interviews revealed also the need for online courses. The idea behind the combination is the need for combining easy to access and flexible online training possibilities (including online courses, but as well as webinars to specific topics) on the one hand and possibilities to have personal contact in face-to-face trainings on the other hand.

The peer-to-peer training concept has been assessed as a good idea by the interview partners, but was also seen as quite challenging regarding the acquisition of the “right” trainers that are competent and trustful, and the high organisational effort needed to ensure this concept.
Public authorities were assessed as the main target group for the CAPITAL training programme.

2.3.2. Specific capacity needs of public authorities
As public authorities have been identified as main trainee target group of CAPITAL, the basic idea of this chapter is to identify specific needs for this target group. According to the results of the chi-square tests of independence and the data collected with the questionnaire, the needs of public authorities do not differ substantially from the other target groups. The only main difference could be identified when considering the main interests for training and the preferred training types. “Financing and funding opportunities” is a main interest for public authorities (especially for cities and regional authorities) and should be considered in the training programme, whereas this topic is of minor relevance for other stakeholder groups. Missing visibility of the benefits of ITS is also of specific relevance for public authorities, as investment decisions are often based on the knowledge of the costs and benefits.

Regarding all other aspects, the aforementioned conclusions should be considered.

2.3.3. Specific capacity needs of professional end-users
As mentioned before, the needs of the professional end-users are very specific. Their needs are assessed as part of the activities of IRU addressed with a literature study and will be transferred into a specific training programme for professional end-user training. These activities will be combined with the activities of the IRU academy in order to ensure that the target group will be reached in an appropriate way. Therefore, no specific training programme for professional end-users is planned within CAPITAL.

Regarding the specific needs of the professional end-users it can be stated that:

- The main need is a training on ADAS.
- Truck drivers, as well as transport operators need to be trained, and
- an European wide qualification programme is needed to provide specific professional education and technical skills for professional drivers.

Based on the conclusions and the existing results of the activities in task 2.2, as well as the outcomes of task 2.3, which will be described in the following chapter, basic recommendations for the elaboration of the training programme within CAPITAL have been formulated in chapter 4.
3. Case studies and business models

This chapter summarises the outcomes of task 2.3. of CAPITAL (Collect case studies and business models). The results of task 2.3. will feed into task 2.4. (Develop an online deployment transferability handbook) as well as into WP 3 (both led by VTT).

3.1. Procedure and methods for collection the case studies and assessment of business models

3.1.1. Collection of business models

This study seeks to familiarize the readers with the current state of ITS and C-ITS applications in real life and possible evaluation methods of suitable business models for future ITS applications. The chosen method is literature review, because the purpose of the study is to gain a general understanding of the current state. The material for the study was collected mainly through project reports, academic journals and online sources including online magazines and Annual Reports. The chosen material was identified as relevant to describe; the case studies and their business models, and case companies’ business models in relation to existing tools of modelling business models.

3.1.2. Selection of presented case studies

We chose two central cases for the analysis: ESC-systems (Electronic Stability Control) and GLOSA (Green Light Optimal Speed Advice). ESC was chosen as one of the case examples because it is an ITS-application which has shown potential, first in research and then during introduction to market (High-class vehicles) and later standardization for all vehicles in Europe and United States. The development path from innovation to widespread technology is helpful in validation of other potential technologies in the field of ITS.

GLOSA has been chosen for its’ different state of development compared to ESC, GLOSA is still in the development phase. Ex-ante impact assessments have been made on the GLOSA and results have been promising. Furthermore, GLOSA is one of the most prominent C-ITS applications that offers clear potential from a societal point of view.

For both cases, there is substantial amount of data and documentation available. Various research projects have been conducted concerning both cases. However, availability of research reports is limited for the GLOSA case, not only due to the pre-market phase of the development but also due to the sensitivity of the findings that are made in cooperation with companies and thus not available to the public. In addition, company-specific business models for ESC-systems are internal information in the car companies and contract details are not available. However, a number of general reviews of the market are available.
3.2. Analysis of selected case studies

3.2.1. ESC Electronic Stability Control - Case example of IVSS (Intelligent Vehicle Safety Systems)

Description
In the 1980's, the first vehicles with assisted braking were built, the Toyota Crown (1983) was the first model with a four-wheel control and power steering applications. Mercedes-Benz and BMW introduced their first models with TSC, (Traction Control System), a system to exploit individual wheel braking features, but in the 1980s, unlike the ESC, systems did not successfully aid steering.

In 1995, Mercedes-Benz, BMW and Toyota each introduced the first models with an ESC system. Mercedes-Benz produced the technology accompanied with Bosch, BMW also had Bosch and also Continental as their partner. During the next few years, Volvo and Audi also introduced their versions of ESC. During the first years of ESC, it was a feature available only in high-end cars, (Mercedes S 600, BMW 7-Series, Toyota Crown Majesta, Audi A8 / A6 Quattro).

Since the introduction of the system, ESC has been the subject of numerous research studies, especially after the wider introduction of the technology. Benefit-cost ratio has unanimously been found substantial, and as a consequence of encouraging results, the technology has spread widely almost into the full range of cars. According to European Commission, Benefit-Cost ratio of ESC-system is close to 4 in new cars.

ESC systems roll out, has been rapidly spreading from luxury cars to all cars, especially in Europe. At the forefront of ESC introduction, is Sweden as in 2006 over 90% of new cars sold in Sweden were fitted with electronic stability control. In 2007, legislation was passed in the US to make ESC mandatory standard equipment for all new passenger cars, and from 2012 for trucks, buses and other large vehicles.

Analysis

List of actors involved in the infrastructure:

- **Customer / end user**: The end user of the car is the final decision-maker who is picking the car from alternatives. European Union Directives (SOURCE) have set ESC mandatory for all new cars, so at the time, choice of taking a car with or without ESC is limited to market of used cars. The decision is significant though, because in Germany only, used car / new car ratio is 2.2: 1.

- **Vehicle manufacturer**: The vehicle manufacturer is the main operator and node of the car development. The trend has been that car manufacturers have merged into large entities that control their own network of suppliers. The role of car manufacturers has shifted more and more over time, into network organizer that steers the development and sets standards for the suppliers (Zimmer et al. 2017) On the other hand, suppliers are more involved in the innovation and development of new technologies.
• **Suppliers:**
  - **Tier 1:** Tier 1 suppliers in the car industry are typically large manufacturers that manage a large supplier network of their own. In addition, large first tier suppliers are cooperating with various car manufacturers. The world’s largest suppliers in the vehicle industry are Robert Bosch GmbH (Germany), with revenue of $44 billion (in automotive parts sales), Denso Corporation (Japan), and Continental AG (Germany).
  - **Tier 2, 3, etc.:** Tier 2 suppliers are providing the tier 1 suppliers with parts necessary and not perceived in the core of the focal company. For example, ESC-system manufacturers, such as Bosch, are utilizing hundreds of second tier suppliers providing materials, cases, electric components, software, cables etc. Upstream suppliers are specified in more narrow range of manufacturing and they have a more specified scope in the market.

• **Legal organisation/Regulator:** Obviously, regulators have played an important role in ESC deployment. European Commission declared mandatory ESC in November 2011 for new models and in 2014 for all new cars. In the US, mandatory ESC was regulated in 2012 for all new cars.

“Value network”, actors and cash flows, other actions

The following figure (Figure 24) presents a value map of Bosch, a leading ESC-system manufacturer in Europe. The main groups of initiatives presented are Substitutes (competitors) on the left, Customers on the top, Suppliers on the bottom and Complements on the right hand side.
**Business models**

Since the introduction of ESC in mass production of luxury cars, the system has gathered substantial attention in research and public discussion. Car users willingness to pay for the system has been regularly examined before the system became mandatory, and market penetration was growing rapidly before 2011 (Öörni, 2015). Since The European Commission declared ESC mandatory for all the vehicles, the system is in all new cars and business model options for the system are narrower from the manufacturer point of view.

A number of OEM car manufacturers (Original Equipment Manufacturer, the company that is directly connected to end customer) have branded similar system in different ways, ranging from ESP (Electronic Stability Program) in Volkswagen, Audi, Ford etc. to VSC (Vehicle Skid Control) in Toyota and DSTC (Dynamic Stability and Traction Control) in Volvo. These systems are similar but different system suppliers induce differences in applications. Since the usage of ESC systems as a provider of competitive advantage has turned almost impossible, OEM’s tend to use cost-minimizing strategy in them. The pressure on cost-reductions has hit the suppliers of the systems as well and system manufacturers, such as Bosh are required to streamline their operations and to introduce lean thinking into their supply chains (Yildiz et al. 2010).

**Current state vs. requirements for application**

ESC systems manufacturers have established their positions in the car industry and the market has eventually reached a mature state where margins are small. On the other hand, suppliers of ESC and other similar systems are large companies that have gained significant power in the supply chain. The largest suppliers are eventually gaining market-share from the whole of the value produced in the automotive industry. Also, the part suppliers have gained power and ability to influence the industry as a whole.

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**Figure 25:** Largest car parts suppliers compared to some car manufacturers, source: https://operationsroom.wordpress.com/2014/05/19/shifting-power-in-auto-supply-chains/
However, safety is still a differentiating factor for manufacturers, as an example Volvo is promising “Death-proof” cars in 2020. The next step is to connect the ESC system to another data based systems in order to reach a higher level of safety.
3.2.2. GLOSA (Green Light Optimal Speed Advisory)

**Description**

GLOSA is a C-ITS-application based on applying censors and wireless control between vehicles and OBUs (On Board Unit) and RSUs (Road Side Unit) that are connected to traffic lights. The goal of the system is to enhance traffic flow and safety and reduce emissions. For the end-user, the system has advantages including reducing fuel consumption and making travel more comfortable.

The GLOSA system is based on a central unit that computes the optimal speed for a vehicle approaching traffic lights. It exploits the information about the speed of a vehicle, speed limit and distance to the traffic lights.

In the research field, there are different protocols to control intersections. According to Lebre et al (2015) there are five different protocols; 1. Reservation: the vehicle sends a request of reservation for space and time, which is then accepted or not accepted by the server, 2. Cooperative Adaptive Cruise Control (CACC): Server detects conflicts in intersections and sends requests to vehicles to accelerate or deaccelerate in order to avoid collisions. 3. Sequence: the intersection is controlled by sequencing access of the vehicles. 4. Green Light Optimal Speed Advisory (GLOSA): vehicle adapts its speed according to data received from the intersections. 5. Traffic Light Control (TLC): different phases of traffic are controlled and vary according to real traffic flow. The first four of these are based on interaction between the vehicles and intersection (RSU), and in the last one, the control is carried out by the intersection. Here, we are focusing primarily on GLOSA.

There are two separate technological solutions in implementing the GLOSA. The two ways of implementing the GLOSA system are Cooperative GLOSA and Connected GLOSA. Cooperative GLOSA exploits an OBU attached to the car. Contrary to Cooperative GLOSA, Connected GLOSA exploits mobile phone application to gather the location data of the vehicle as well as to inform about the suggested driving speed.

“The results suggest that the GLOSA application has a positive effect on both performance metrics. The higher the GLOSA penetration rate is, the more benefits we have with a maximum of 80% reduction in stop time and up to 7% reduction in fuel consumption in a high traffic density scenario. There is a critical point of 50% of equipped vehicles where the effect of GLOSA starts to be more visible on fuel consumption” (Katsaros et al. 2011).

**Analysis**

**List of actors involved in the infrastructure:**

- **Vehicle Owner** (consumer / corporate user): The vehicle owner is the customer of GLOSA Service provider. It can be consumer, corporate or public user. The service user might be different person to the owner, for example, rental car user or bus driver, who do not own the vehicle they are using.
- **Road operator**: The road operator is a public initiative that is responsible for the road- and traffic light maintenance. The road operator possesses information on optimal traffic light management and optimal speed profiles on the roads.

- **Service provider**: The Service Provider is the focal organisation in the GLOSA system, it handles the majority of the activities in the GLOSA system. The Service Provider is responsible for managing the system and sending advice about optimal speed to the customer. It also receives payments from the customers and depending on the technical framework, pays for the OBU provider.

- **RSU provider**: Provides the Road Side Unit (RSU), its installation and depending on the case, also handles its maintenance. The RSU Provider could sell the hardware or provide it as a service.

- **OBU provider (not included in connected GLOSA)**: The OBU Provider manufactures the OBU to an existing car or in cooperation with a car manufacturer, delivers the OBU to a new car. A distinct OBU-device is not necessarily needed in a Connected GLOSA system, because contrary to Cooperative GLOSA, the system is using mobile application.

**“Value network”, actors and cash flows, other actions**

Depending on the composition of the consortium and companies involved, different formations and Value Nets are built. In a value net of a system such as GLOSA, which involves sensitive traffic information, public initiatives and Road Operators are almost necessarily involved in the value net. The most critical factor is, however, to be able to build a model that is bringing value to the customer. It is also critical to find a viable business model that is attractive in terms of investment. The focal company in GLOSA system is the Service Provider. The following Figure 26 identifies the Value Net that is perceived from the perspective of GLOSA Service Provider.
Figure 26: GLOSA Value network from the Service Provider point of view

**Business models**
A central issue in decision making related to applying the GLOSA system to real life, is the principle of monetization and the legal environment established by public initiatives. Naturally, the technical organization of the service is defining the entity significantly. Most importantly, whether the system operates with the technology of *Cooperative GLOSA* or *Connected GLOSA*.

Within Cooperative GLOSA, Road Operators create optimal time profiles for the traffic lights and forward them to Service Provider, who calculates the speed advice that is sent to the driver. OBU and RSU providers are supplying the system with the right equipment. As in the picture, driver (vehicle owner) is gaining increased comfort and decreased fuel consumption and as in the presented model, vehicle owners are paying service fees to the service provider. However, the business model could be organized in number of different ways.
Connected GLOSA is implemented using a mobile application, so the OBU Provider is not needed. Other parts in the business model: RSU Provider Road operator and Service Provider are working in a similar way to the previous business model. Service fees for Drivers (presented in the Figure 28) are optional for an informed driving experience.

Despite the choice of the type of GLOSA and the technology used in it, the greatest private risk falls on the service provider. However, investments on the technology such as RSU and possibly OBU could be shifted to the manufacturers.
Current state vs. Requirements for application

Based on the initial research, GLOSA system has proven its ability to produce significant value in savings of fuel as well as collision avoidance. However, in order to reach the critical point and get significant fuel savings, GLOSA-equipped vehicles penetration rate should be at least 50%. Even smaller rates will benefit significantly through decreasing traffic density. According to Katsaros et al (2011), the optimal distance to notify the driver before traffic lights is about 300 meters - depending a little on the road network.
3.3. Assessment of business models

3.3.1. Assessment of ESC
From the launch of first ESC-systems in 1995, promising results have motivated governmental initiatives from EU-level to national governments to speed up the deployment of ESC-systems. However, the result of studies on customer willingness to pay for the service did not support the across-the-board deployment of the technology, especially in smaller vehicles. From the beginning, the technology has proven potential. Successful business models were first based on the business model between ESC-system supplier who was involved in the innovation of new technology installed in high-end cars that were supposed to show the manufacturers pioneering position in the industry. However, transition of the market ecosystem into regulated system where the ESC is mandatory, shifted the ESC-technology from luxury level high-margin extra-feature into mandatory source of cost, but even now, car manufacturers try to make use of the technology in marketing communications.

When looking at the EU car industry, two types of networks can be distinguished; formal (clusters) and informal (strictly based on trust and credibility) and project-based. Typically, the latter one consists of networks initiated by the research centres. The vehicle market has turned to, even more than before, an innovation race between manufacturers and their networks. (Dodourova, Bevis 2014)

In a rapidly evolving industry such as car industry, the first adopters of technologies are the ones to gain a significant competitive advantage in the competition of networks. Thus from the ESC suppliers perspective, it is crucially important to keep up in the innovation race and to integrate the new innovations with the existing technology such as ESC.

3.3.2. Assessment of GLOSA
In order to start developing into a solution for real life traffic management, GLOSA needs a strong and coordinated network of actors including public and private entities. As a part of Drive C2X - project, (European Commission -funded project, which took place in 2011-2014) project, GLOSA has been found to be one of the most useful solutions by the final users. The initial application models for GLOSA are connected with other Connected ITS-applications because the costs of applying technology could be minimized through using the same technology in different applications. As presented in the MOBiNET report (2016), possible payment methods are the following:

1. Road authority pays to have it offered to users for free (to reduce emissions) or
2. End-user pays to save fuel

However, both of these models pose a risk in the willingness to pay - road authorities may not necessarily have direct financial advantage of reduced emissions, the first model would need a strong external pressure. In addition, the second model is problematic, because end-users have a relatively small willingness to pay for the service.
3.4. Mapping of business models

The following table presents the classification of business models of some of the most centric ITS and C-ITS systems. There are eight recognized categories for business models, and also genres “other” and “combination of several of 1-9 are included:

1. ITS-system as a stand-alone project, (B2B)
2. ITS system as a stand-alone product (B2C)
3. ITS system as a complementary product/service
4. ITS system as a public good
5. Business model involving a two-sided market
6. ITS system supporting stakeholder’s other business activities (providing monetary or non-monetary benefits)
7. ITS system supported by advertising revenue
8. Monetization of user generated data
9. Other
10. Combination of more than one of 1-9

It seems that, at the moment, almost all of the ITS and C-ITS applications are based on several business models, not only one. This is the case also with GLOSA system, which includes some variations and aspects of more than one typical business model.
### ITS Systems

<table>
<thead>
<tr>
<th>Infrastructure based priority systems</th>
<th>Real time travel and traffic information (RTTI)</th>
<th>eCall</th>
<th>Dynamic traffic management</th>
<th>Speed alert</th>
<th>Dynamic navigation systems</th>
<th>Local danger warnings</th>
<th>Eco-driving coaching</th>
<th>Extended environmental information (Extended FCD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2, 3</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
</tr>
</tbody>
</table>

| Vehicle based priority systems       | Lane keeping support                        | 4     | 4                            | 9          | 9                         | 14                  | 9                    | 9                                             |
|                                      | Eco-driving assistance                      |       | 8                            |            |                           |                     |                      |                                               |
|                                      | Emergency braking                           | 7     |                              |            |                           |                     |                      |                                               |
|                                      | Blind spot monitoring                       | 6     |                              |            |                           |                     |                      |                                               |
|                                      | Obstacle and collision warning (including ACC) | 4, 5  |                              |            |                           |                     |                      |                                               |

### Cooperative ITS system

| Day 1 applications                  | Slow or stationary vehicle(s) & Traffic ahead warning | 15    | 15                           | 10, 13     | 15                        | 10                  | 15                  | 15                                           |
|                                      | Road works warning                           |       |                              | 13         | 10                        | 15                  | 13                  | 15                                           |
|                                      | Weather conditions                           |       |                              |            | 10                        |                     | 13                  |                                               |
|                                      | Emergency brake light                        |       |                              |            |                           |                     | 15                  |                                               |
|                                      | Emergency vehicle approaching               |       |                              |            |                           |                     | 15                  |                                               |
|                                      | Other hazardous notifications                |       |                              |            |                           |                     | 13                  |                                               |
|                                      | In-vehicle signage                           |       |                              |            |                           |                     | 13, 15              |                                               |
|                                      | In-vehicle speed limits                      |       |                              |            |                           |                     | 15                  |                                               |
|                                      | Signal violation / Intersection Safety       |       |                              |            |                           |                     | 15                  |                                               |
|                                      | Traffic signal priority request by designated vehicles | 15    |                              |            |                           |                     |                     |                                               |
|                                      | Green Light Optimal Speed Advisory (GLOSA)   |       |                              |            |                           |                     | 15                  |                                               |
|                                      | Probe vehicle data                           |       |                              |            |                           |                     | 2, 10               |                                               |
|                                      | Shockwave Damping (falls under ETSI Category “local hazard warning”) | 12, 13 |                              |            |                           |                     |                     |                                               |

| Day 1½ services                     | Information on fuelling & charging stations for alternative fuel vehicles | 16    |                              |            |                           |                     |                     |                                               |
|                                      | Vulnerable Road user protection              | 11    |                              |            |                           |                     |                     |                                               |
|                                      | On street parking management & information   | 10    |                              |            |                           |                     |                     |                                               |
|                                      | Off street parking information               |       |                              | 2, 10      |                           |                     |                     |                                               |
|                                      | Park & Ride information                      |       |                              |            |                           |                     |                     |                                               |
|                                      | Connected & Cooperative navigation into and out of the city (1st and last mile, parking, route advice, coordinated traffic lights) | 10    |                              |            |                           |                     |                     |                                               |

### Table 3: Classification of business models

<table>
<thead>
<tr>
<th>1. ITS system as a stand-alone product (B2B)</th>
<th>2. ITS system as a stand-alone product (B2C)</th>
<th>3. ITS system as a complementary product/service</th>
<th>4. ITS system as a public good</th>
<th>5. Business model involving a two-sided market</th>
<th>6. ITS system supporting stakeholder’s business activities (providing monetary or non-monetary benefits)</th>
<th>7. ITS system supported by advertising revenue</th>
<th>8. Monetization of user generated data</th>
<th>9. Other</th>
<th>10. Combination of more than one of 1-9</th>
</tr>
</thead>
<tbody>
<tr>
<td>2, 3</td>
<td>1</td>
<td>1</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>9</td>
<td>2, 3, 9</td>
</tr>
</tbody>
</table>
3.5. Conclusions

Based on current knowledge, it seems that business models in the CAPITAL applications are typically rather complex and consist of number of actors rather than a single company providing services. Typically, systems are building an infrastructure including various initiatives related to providing the technology, such as software industry, manufacturers of the technology, service provider, network connection provider, several public initiatives and the end user. In many cases, there are supply-chains consisting of number of nodes. For example, ESC-systems are a typically a product of a more traditional vertical supply chain with Tier 1, Tier 2, etc. suppliers. In the case of GLOSA, the business ecosystem is different, consisting of initiatives related to new business, IT-communications and data handling activities. Innovation in building the new business is a result of cooperation in the Open Innovation network.

The most common business models in the CAPITAL framework are rather similar in the way they work. In order to get the solutions to the market, clusters are needed, both for connecting companies and public initiatives together, but also to connect different projects related to ITS and road safety. A possible model for forming the clusters is to connect related Infrastructure-based systems together and at the same time, vehicle-based systems together. Many of the solutions are based on the same sensors and data, such as GPS trackers in the cars and driving line tracking. Also, many applications require a connection to a communication network, so one unit to carry out all the activities would be saving costs.

To summarize, the ESC application was proven viable for business by its rapid take-over of the upper-middle class and high-class car market. However, ESC was not likely to extend into market-wide use without regulatory power. GLOSA seems to be in a more difficult position in terms of commercialization; the system requires investment of number of different actors, and is not necessarily viable for business without coordination and promotion of public initiatives. Based on Metcalfe’s law, the value of the network is proportional to the square of the amount of connected users in the networks. Similarly, C-ITS systems with as many connections as possible are likely to produce more value to the system. The adaption of the new (standardized) technologies into the vehicles is slow due to the slow renewal rate of fleet of cars. The following table shows that the shipments of Anti-Skidding and ESC-systems (million units) are growing rapidly, and eventually reaching the annual car sales. However, old cars will stay in the market for a long time.
**SHIPMENTS OF ANTI-SKIDDING AND ELECTRONIC STABILITY CONTROL SYSTEMS, BY VEHICLE TYPE, THROUGH 2019 (MILLION UNITS)**

<table>
<thead>
<tr>
<th>Vehicle Type</th>
<th>2012</th>
<th>2013</th>
<th>2014 (est.)</th>
<th>2019</th>
<th>CAGR% 2014-2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cars</td>
<td>35.7</td>
<td>43.0</td>
<td>50.9</td>
<td>104.3</td>
<td>15.4</td>
</tr>
<tr>
<td>Other vehicles</td>
<td>10.0</td>
<td>12.0</td>
<td>14.1</td>
<td>27.9</td>
<td>14.6</td>
</tr>
<tr>
<td>Total</td>
<td>45.7</td>
<td>55.0</td>
<td>65.0</td>
<td>132.2</td>
<td>15.3</td>
</tr>
</tbody>
</table>

Figure 30: Shipments of Anti-Skidding and ESC-systems, million units (BCC Research 2015)
4. Recommendations for the elaboration of the CAPITAL training programme

The aim of CAPITAL project is to support public and private stakeholders in the implementation of (C)-ITS with training and educational resources. For identifying the needs various activities were carried out within the first months of the project. The results of the different tasks have been presented in the previous chapters. Based on exactly these results a couple of recommendations have been formulated as a guideline and input for the elaboration of the further training programme in the upcoming work packages. The recommendations for the development of the CAPITAL training programme are summarised below:

- **Public authorities** are the main target group for the CAPITAL training programme.

- The training programme should focus on a meta level on the main priority topics, which are: “Access and Management of Data”, “C-ITS”, “Passenger Transport Services”, “Traffic Management and Network Control” and “Traveller Information Services”.

- The training activities developed should specifically target the different know-how levels with different priority topics.

- Training programmes for ITS starters (1st level) should focus (according to the results) on: “Traffic control in urban areas”, “Access to dynamic transport data”, “Integrated Traffic Management” and “C-ITS in urban areas”. Training measures for 2nd level ITS practitioners should focus on “Event Detection and Transport Data Collection”, “Safety and Security for Passenger Transport” and “Multimodal Journey Planning”. Training courses for 3rd level ITS experts should cover also the topic “Event Detection and Transport Data Collection”, as well as “C-ITS on high level road network”, “Aggregation and Management of Transport Data” or “Access to Dynamic Transport Data”.

- When covering these priority topics, the specific main interest for a training will be on sharing best-practice cases with the trainees and furthermore to train the ITS practitioners on evaluation methods and cost-benefit analysis of ITS services. Furthermore, training on procurement issues for innovative solutions and business-models for ITS services should be included in the CAPITAL training programme. The business-models collected and analysed in task 2.3. and described in chapter 3 will build an important basis for this.

- In principle, there is no need to develop training programmes for the different stakeholder groups, as the identified priority topics and main interests for training are similar for the different groups with the exception that public authorities are interested in the topic of “Financing and Funding ITS implementation” (in contrast to the other groups).
- When developing the training programme a combination of easy to access and flexible online training possibilities (including online courses and webinars) and face-to-face training possibilities (as workshops and on-site visits) should be planned.

- In addition to the online tool, face-to-face training possibilities are important for the personal contact and to build a network appropriate for mutual learning, but also for further cooperation. Furthermore, workshops are an important tool for interaction between the trainers and trainees and for the personal exchange of information and experiences with others with the same background and the same problems.

- The face-to-face trainings should be local workshops or workshops with local participant specifically dedicated to the needs of the participants in the region or geographical area.

- The training should be very practical or hands-on training appropriate for people who are working in the area of ITS or who will be involved in the deployment of ITS (e.g. including on-site visits).

- The training programme should also be used to build up networks of trust and therefore enable mutual learning and better cooperation in the ITS sector.

- The need for cooperation and coordination in a multi-stakeholder environment is one of the most important barriers for the implementation of ITS. Training activities should call attention to this barrier and prepare ITS starters to deal with this challenge (e.g. through experience exchange and best-practices) and organise dedicated activities that foster further cooperation and coordination (on local level).

- In general, there is a need for raising more awareness for the benefits and costs of ITS in the group of public authorities and on policy level, also outside the CAPITAL training programme. Lack of knowledge on the real impacts of ITS services is as well linked to this issue, and it has high relevance for ITS practitioners.
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Annex

5.1 Web-based questionnaire (English version)

- CAPITAL QUESTIONNAIRE ON PRIORITIES AND TRAINING NEEDS FOR ITS

About CAPITAL

The aim of the CAPITAL (Collaborative cApacity Programme on ITS Training-educAtion and Liaison) is to build a collaborative capacity community and deployment programme to support public and private stakeholders in the implementation of ITS (C-ITS) with training and educational resources which enable knowledge transfer about the benefits and deployment of ITS. The project will assist public and private stakeholders in developing their knowledge, skills, and abilities to build technical, business and policy making proficiency of ITS deployment while furthering their professional development.

Objective of this questionnaire

This survey is especially designed for public authorities, transport operators, transport related service operators, ITS Associations and ITS experts, with different levels of know-how. Please also fill-in the questionnaire if you have no idea what ITS can be. We are also interested in your (training) needs as ITS starter. A short explanation on ITS is also included in this questionnaire.

The main goal of this inquiry is to identify most crucial deployment priorities of ITS from the view of the public hand, best-practices cases as well as major challenges that hinder further ITS deployment. At the same time this questionnaire aims to identify the current level of already existing ITS expertise as well as know-how gaps in different topics, which will help CAPITAL to assess specific training needs and priorities. Building on this information CAPITAL is to develop tailor-made supporting training modules and materials.

The main information gathered by this questionnaire will be:

- Priorities within different ITS deployment topics/fields;
- Collection of best-practices and business models your country/organisation;
- Difficulties that hinder deployment;
- Existing knowledge gaps and training needs;

Thank you for your willingness to share and exchange your expertise! Your input will form valid for further activities in the building of an ITS-learning program to foster ITS deployment.

The completion of this questionnaire should only take about 10-15 minutes of your time.

Thank you for your support!

CAPITAL (Collaborative cApacity Programme on ITS Training-educAtion and Liaison)

project is funded by the European Union's Horizon 2020 Research and Innovation Programme (2014-2020)

Coordinator: ERTICO - ITS Europe
For questions on this questionnaire please contact:
AustriaTech
Katharina Zwick (katharina.zwick@austriatech.at)

- ABOUT YOUR ORGANISATION

Please indicate your country:

☐ Public administration/authority
☐ Transport operator/association
☐ Transport related service provider
☐ Association (e.g. ITS National), Expert in ITS/Transport Field
☐ Other

Please categorise the regional level your organisation is responsible for/operating at:
☐ Local (e.g. community, city, municipality)
☐ Regional (e.g. federal state)
☐ National
☐ International
Please indicate your general knowledge on ITS (please find the definition of the different levels below):

☐ 1st Level - ITS start up communities

☐ 2nd Level - advanced and intermediary communities

☐ 3rd Level - train the trainer/ highly experienced communities

If 3rd Level:

Would you be interested to be a trainer in the upcoming CAPITAL trainings?

☐ No

☐ Yes

Contact Information as trainer:

Name: ________________________________________

Phone: _______________________________________

Email address: ________________________________

CAPITAL will provide training on 3 different levels. Your answers will help us to assess the required levels per ITS deployment topic. The levels as defined here are:

1st Level - ITS start-up communities: You have no or very limited know-how on the deployment of ITS. Your main question is “what is ITS and why is it relevant for me?” Pick this level also if you are a public sector decision-maker in an European Member State with very few or no dynamic traffic management systems and with limited or no real-time traffic information services. Also pick this option if you answer on behalf of cities without urban ITS measures (except traffic lights).

2nd Level - advanced and intermediary communities: You already gained some experience or familiarity with different ITS systems or already deployed ITS applications/services in your sphere of influence. Your main question is “how can I use ITS technologies in an optimum way and which actions should be taken to realise the potential of ITS?”

3rd Level - train the trainer/ highly experienced communities: You have extensive experience in research and deployment of ITS technologies. Pick this level also if you either already trained others in ITS topics or are interested (based on your experience) to develop such a capability. Your main question is “what should I advise or encourage others to do in regards to ITS deployment and research?”

Within the CAPITAL framework, training objectives and outcomes for each ITS level will be defined, potential topic studies for training modules will be identified (also based on your answers).

Only for Level 1:
Assessment of priority topics

In the following section you are asked to assess the priority of the following ITS topics according to the needs of your country/city/region.

ITS – Intelligent Transport Systems – means the application of communication technology to better manage traffic and optimise the utilisation of existing transport infrastructure. This encompasses infrastructure and vehicles as well as physical and digital interfaces between the different modes of transport. The envisaged utilisation of each mode of transport in accordance with its individual benefits will encourage multimodal mobility behaviour and is expected to contribute to saving lives, time, money, energy and the environment. The technologies are potential tools that will help to manage congestion, improve emergency vehicle response, optimise the operational effectiveness of transit systems and provide travellers with real-time information.

The topics are summarized within the following major categories (based on the categorisation of the World Road Association - PIARC):

- Traffic management and network control
- Traveller information services
- Emerging services - Cooperative ITS
- Access and Management of Data
- Passenger transport services
- Maintenance and construction management
- Freight services
In the following you will find a list of suggested priority topics for ITS aggregated to the aforementioned main categories.

Please tick all topics that are of high priority for you in this area (more than one option is possible in each category - if none of the options is of high priority don't tick any option):

**Traffic management and network control:**
ITS applications play an important part in the way road networks are managed to improve the efficiency and reliability of transport operations and reduce negative environmental and energy consumption impacts.

- Traffic control in urban areas (incl. measures for traffic management for roads and interfaces to other modes in urban areas, e.g. demand-responsive traffic management, public transport prioritisation, adaptive signal control systems)
- Traffic control on high level road network (incl. ramp metering and lane control)
- Corridor/area-wide traffic control and management
- Parking management and access control (incl. management of allocation and price, real-time Information on spaces)
- Travel demand management (incl. applications to implement strategies for increasing the frequency of multiple-occupancy vehicles (MOVs) and the use of high-occupancy vehicle lanes (HOVs)
- Collection of emission data for local traffic diversion (meant as usage of environmental sensors to collect information about exhaust emissions from vehicles at a certain location, or over a wide area as input for traffic management (to improve air quality, manage congestion and reduce delay))
- Road-rail intersection (provide improved warning and safety control devices where a railway (railroad) crosses a road or highway at a level crossing)
- Integrated Traffic Management (meant as integrated application of traffic management techniques on strategic routes and the associated network corridor of adjacent roads and interchanges to optimise the flow of vehicles in the combined strategic and local road network. These techniques cover the whole value chain from data collection to service presentation and include the integration of data and services from multiple stakeholders)
Traveller Information Services
According to the definition of the European Commission "Traffic and Travel Information is a key element of Intelligent Transport Systems (ITS) deployment. It can provide the European traveller with door-to-door information for well-informed travel decisions (pre-trip) as well as information during the journey (on-trip)".

☐ Journey planning for individual road transport

☐ Journey planning for rail transport

☐ Journey planning for public passenger transport

☐ Multimodal journey planning (meant as "seamless integration of information for different transport modes" based on the definition of the EC related to the promotion of multimodal journey planners)

☐ Integrated, electronic fare management on local, national or transnational level (enabling travellers to make a journey that involves transfers within or between different transport modes with a single ticket that is valid for the complete journey)

☐ Services based on vehicle sharing concepts (e.g. car sharing, carpooling, bike sharing)

Emerging Services - Cooperative ITS
Cooperative ITS (C-ITS) use technologies that allow road vehicles to communicate with other vehicles, with traffic signals and roadside infrastructure as well as with other road users. The systems are also known as vehicle-to-vehicle communications, or vehicle-to-infrastructure communications. With alerts generated from the increased information available, these systems have a strong potential to improve road safety and the efficiency of the road transport.

☐ C-ITS on high level road network

☐ C-ITS in urban areas
Access and Management of Data
Transport related data is the very basis for ITS applications. Depending on the availability of different data various ITS services can be offered. The availability and the access to the relevant data is a crucial factor, especially when it comes to the cooperation across organisational or national borders.

☐ Event detection and transport data collection (e.g. floating car data, phone data, probe data, CCTV, etc.)

☐ Aggregation and management of transport data (e.g. in a centralised data repository, unified transport graph on regional or national level)

☐ Access to static transport data (e.g. digital maps on transportation network, road types, road conditions, traffic regulations, timetables, etc)

☐ Access to dynamic transport data (e.g. real-time traffic conditions, real-time arrival times, incidents, vehicles positions, delays, etc)

☐ Set-up and management of a National Access Point (in accordance to the COMMISSION DELEGATED REGULATION (EU) 2015/962)

Passenger transport services
ITS applications support public passenger transport operations, starting from services that enable the optimised management of the fleets, tools that support the transport demand management and finally developing integrated passenger transport network systems, that integrate road-based passenger services with other passenger transport modes (trams, light rail, heavy rail) in a co-ordinated system.

☐ Operations and fleet management (e.g. tools to support planning & scheduling, road track management (specifically traffic signal priority), driver/vehicle/passenger management)

☐ Transport demand management (incl. ITS applications to support strategies on transport choices and accessibility, planning and evaluation)

☐ Communications for passenger transport operations management (between the vehicle and data stores, between the vehicle and the control centre, between vehicles themselves)

☐ Safety and security for passenger transport (e.g. CCTV, ‘Help Points’, remote automatic tracking of vehicles,...)

☐ Automated fare collection (meant as electronic payment system that facilitates payment on passenger transport and further can enable integrated transport strategies allowing travellers...)

CAPITAL D.2.2.: Capacity needs and knowledge gaps of ITS stakeholder groups and case study collection
Maintenance and Construction Management
According to the definition of the World Road Association ITS has a lot to offer in terms of supporting and facilitating the maintenance and management of highway infrastructure, winter maintenance operations, as well as improving the management and safety of road construction and work zones. Technology applications range from those aimed at tracking and routing support for maintenance and construction vehicles, to systems designed for monitoring and predicting weather conditions, to applications aimed at construction and work zone management.

☐ Vehicle tracking and maintenance (e.g. tracking of maintenance and construction vehicles, monitoring of the condition of the vehicles,...)

☐ Weather Data Collection, Processing and Dissemination (e.g. the use of environmental sensors for localised weather information including road surface conditions, detection of hazardous condition, information of the public, planning of more effectively winter maintenance operations,...)

☐ Winter Maintenance Operations Support (e.g. monitoring and tracking routes for snow ploughs and grit spreaders)

☐ Work zone management (Information on work zones and construction sites on highways, used e.g. for improved safety (incl. driver warning) or traffic management)

☐ Infrastructure monitoring (to monitor the condition of critical infrastructure such as bridges and road tunnels)

Freight Services
ITS applications can enhance efficiency, safety and cost-effectiveness in the competitive environment of freight operations.

☐ Urban freight management (incl. collection and delivery, management of delivery zones,...)

☐ Intelligent truck parking (incl. the provision of information services for safe and secure parking places for trucks and commercial vehicles. in regard to the Article 3(e) of Directive 2010/40/EU (ITS Directive))

Additional High Priority Topics
If you are missing topics that are of high priority for you and your organisation, please indicate them in the textbox below.

I am missing the following high priority topic(s):
Only for Level 2 and 3:

**- PRIORITY TOPICS, DEPLOYMENT AND MAJOR CHALLENGES**

Assessment of priority and deployment topics

In the following section you are asked to assess the priority of the ITS topics according to the needs of your country/city/region. Furthermore we would like to know in which topics you already deployed ITS applications and what you identified as the major challenges in regard to ITS deployment.

This section will help CAPITAL to identify the most relevant ITS areas for trainings, but furthermore to reveal the needs when it comes to the deployment of ITS. Based on your experience and the learnings of the ITS community CAPITAL will elaborate specific training modules, that can be know-how exchange opportunities, support on legal questions, ideas on different business models or funding and financing options.

The topics are summarized within the following major categories (based on the categorisation of the World Road Association):

- Traffic management and network control
- Traveller information services
- Emerging services - Cooperative ITS
- Access and Management of Data
- Passenger transport services
- Maintenance and construction management
- Freight services
In the following you will find a matrix for each major category mentioned before. For each matrix we would ask you to tick your priorities, but also the status of deployment (where relevant). These deployment cases can serve as future experiences or best-practices.

Please tick for each topic,

- if the topic is of high priority for you/your organisation/your country (A) - More than one topic can be marked as high priority in each matrix. If none of the topics in a matrix is of high priority for you tick nothing.

- if you plan to deploy (B1), are currently deploying (B2) or already deployed (B3) an ITS application in this area

  (Important remark: even if you deploy an ITS application in a topic this is NOT NECESSARILY A HIGH PRIORITY topic! So maybe you haven’t marked the topic under A, even when you choose B1-B3, than we don’t consider this topic as high priority for you).

- if the topic is of high priority, but due to different reasons the deployment is not planned (C)

You will find a little more detailed explanation for the different topics below the respective matrix.
Traffic management and network control

ITS applications play an important part in the way road networks are managed to improve the efficiency and reliability of transport operations and reduce negative environmental and energy consumption impacts.

<table>
<thead>
<tr>
<th>Traffic control in urban areas</th>
<th>High Priority Topic (A)</th>
<th>Deployment PLANNED (B1)</th>
<th>Deployment IN PROGRESS (B2)</th>
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<tbody>
<tr>
<td>Traffic control on high level road network</td>
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<td>Corridor/area-wide traffic control and management</td>
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<td>Parking management and access control</td>
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</table>

Traffic control in urban areas (incl. measures for traffic management for roads and interfaces to other modes in urban areas, e.g. demand-responsive traffic management, public transport prioritisation, adaptive signal control systems)

Traffic control on high level road network (incl. ramp metering and lane control)

Corridor/area-wide traffic control and management
Parking management and access control (incl. management of allocation and price, real-time information on spaces)

Travel demand management (incl. applications to implement strategies for increasing the frequency of multiple-occupancy vehicles (MOVs) and the use of high-occupancy vehicle lanes (HOVs))

Collection of emission data for traffic diversion (meant as usage of environmental sensors to collect information about exhaust emissions from vehicles at a certain location, or over a wide area as input for traffic management (to improve air quality, manage congestion and reduce delay))

Road-rail intersection (provide improved warning and safety control devices where a railway (railroad) crosses a road or highway at a level crossing)

Integrated Traffic Management (meant as integrated application of traffic management techniques on strategic routes and the associated network corridor of adjacent roads and interchanges to optimise the flow of vehicles in the combined strategic and local road network. These techniques cover the whole value chain from data collection to service presentation and include the integration of data and services from multiple stakeholders)
**Traveller Information Services**

According to the definition of the European Commission "Traffic and Travel Information is a key element of Intelligent Transport Systems (ITS) deployment. It can provide the European traveller with door-to-door information for well-informed travel decisions (pre-trip) as well as information during the journey (on-trip)".

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<th>Service</th>
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**Journey planning for individual road transport**

**Journey planning for rail transport**

**Journey planning for public passenger transport** (incl. road-based passenger services as buses, coaches, taxis, etc as well as other passenger transport modes as trams, light rail, etc)

**Multimodal journey planning** (meant as "seamless integration of information for different transport modes" based on the definition of the EC related to the promotion of multimodal journey planners)

**Integrated, electronic fare management** on local, national or transnational level (enabling travellers to make a journey that involves transfers within or between different transport modes with a single ticket that is valid for the complete journey)
Emerging Services - Cooperative ITS

Cooperative ITS (C-ITS) use technologies that allow road vehicles to communicate with other vehicles, with traffic signals and roadside infrastructure as well as with other road users. The systems are also known as vehicle-to-vehicle communications, or vehicle-to-infrastructure communications. With alerts generated from the increased information available, these systems have a strong potential to improve road safety and the efficiency of the road transport.

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C-ITS on high level road network

C-ITS in urban areas
**Access and Management of Data**

Transport related data is the very basis for ITS applications. Depending on the availability of different data various ITS services can be offered. The availability and the access to the relevant data is a crucial factor, especially when it comes to the cooperation across organisational or national borders.

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<td><strong>AGGREGATION AND MANAGEMENT of transport data</strong></td>
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<td>Access to STATIC transport data</td>
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<td>Access to DYNAMIC transport data</td>
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**Event detection and transport data collection** (e.g. floating car data, phone data, probe data, CCTV, etc.)

**Aggregation and management of transport data** (e.g. in a centralised data repository, unified transport graph on regional or national level)

**Access to static transport data** (e.g. digital maps on transportation network, road types, road conditions, traffic regulations, timetables, etc)

**Access to dynamic transport data** (e.g. real-time traffic conditions, real-time arrival times, incidents, vehicles positions, delays, etc)

**Set-up and management of a National Access Point** (in accordance to the COMMISSION DELEGATED REGULATION (EU) 2015/962)
**Passenger transport services**

ITS applications support public passenger transport operations, starting from services that enable the optimised management of the fleets, tools that support the transport demand management and finally developing integrated passenger transport network systems, that integrate road-based passenger services with other passenger transport modes (trams, light rail, heavy rail) in a co-ordinated system.

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**Operations and fleet management** (e.g. tools to support planning & scheduling, road track management (specifically traffic signal priority), driver/vehicle/passenger management)

**Transport demand management** (incl. ITS applications to support strategies on transport choices and accessibility, planning and evaluation)

**Communications for passenger transport operations management** (between the vehicle and data stores, between the vehicle and the control centre, between vehicles themselves)

**Safety and security** for passenger transport (e.g. CCTV, ‘Help Points’, remote automatic tracking of vehicles,....)

**Automated fare collection** (meant as electronic payment system that facilitates payment on passenger transport and further can enable integrated transport strategies allowing travellers to use a common method of payment for all public transport modes on all operator’s routes)
Maintenance and Construction Management

According to the definition of the World Road Association ITS has a lot to offer in terms of supporting and facilitating the maintenance and management of highway infrastructure, winter maintenance operations, as well as improving the management and safety of road construction and work zones. Technology applications range from those aimed at tracking and routing support for maintenance and construction vehicles, to systems designed for monitoring and predicting weather conditions, to applications aimed at construction and work zone management.

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<td>Weather Data Collection, Processing and Dissemination</td>
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<td>Winter Maintenance Operations Support</td>
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<td>Work zone management</td>
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<td>Infrastructure monitoring</td>
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**Vehicle tracking and maintenance** (e.g. tracking of maintenance and construction vehicles, monitoring of the condition of the vehicles,...)

**Weather Data Collection, Processing and Dissemination** (e.g. the use of environmental sensors for localised weather information including road surface conditions, detection of hazardous condition, information of the public, planning of more effectively winter maintenance operations,...)

**Winter Maintenance Operations Support** (e.g. monitoring and tracking routes for snow ploughs and grit spreaders)

**Work zone management** (Information on work zones and construction sites on highways, used e.g. for improved safety (incl. driver warning) or traffic management)

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**Infrastructure monitoring** (to monitor the condition of critical infrastructure such as bridges and road tunnels)

**Freight Services**

ITS applications can enhance efficiency, safety and cost-effectiveness in the competitive environment of freight operations.

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**Urban freight management** (incl. collection and delivery, management of delivery zones, ...))

**Intelligent truck parking** (incl. the provision of information services for safe and secure parking places for trucks and commercial vehicles. in regard to the Article 3(e) of Directive 2010/40/EU (ITS Directive))

**Additional high priority topics**

If you are missing topics of high priority for you and your organisation, please indicate them below:

**Additional deployment related topics**

You are currently deploying or already deployed an ITS application not covered by the topics above? Then please indicate the topic and application in the textbox below.
MAJOR CHALLENGES, BEST-PRACTICE AND BUSINESS MODELS

Identification of major challenges and best-practices

As you already gained experiences with ITS deployment we would be interested in your assessment of major challenges and difficulties that hinder ITS deployment - either the next step or the deployment in general. This information will help CAPITAL to assess if specific needs and knowledge gaps exist, that can be reduced or removed with support and training.

Furthermore we would be interested in your best-practice and business models for the deployment of ITS. Best-practice cases are one of the most important learning tools in the ITS sector. We would be happy if you are willing to share your valuable experience.

If you already deployed (or currently deploying) ITS applications - What do you see as major challenges and difficulties that hinder (the next step of) deployment of ITS applications (in your sphere of influence)?

☐ I don’t see any barriers.

☐ The knowledge required for the technical implementation is not available

☐ The cost and benefits of such a system are not known

☐ The procurement is too complex or an adequate model for procurement is missing

☐ The best organisational structure/business model for such a system is not clear

☐ There is a lack of resources to finance further implementation

☐ Politicians do not see it as a goal at the moment

☐ Authorities are not willing to deploy this solution, because... (comments possible in the next step)

☐ The risk is too high, because... (comments possible in the next step)

☐ Other barriers

Optional: Can you provide us with more detailed information authorities are not willing to deploy/risk is too high?
If you have any additional comments regarding the major challenges and difficulties, please use the textbox below.

______________________________________________________________________________________

Best-practices and business models
One key issue for learning in the ITS sector is the valuable experience of ITS practitioners. The following questions focus only on those ITS applications that you have fully deployed.

If you don't have any information on best-practice and business models, you can skip this section.

☐ I don't have any best-practice examples to share - SKIP this section

______________________________________________________________________________________

Best-practices and business model description

Please describe your best-practice case or business model other ITS practitioners can learn of (if you have more than one you will have the opportunity to add them separately in the next step):

______________________________________________________________________________________

If you have any additional information material on your best-practice or business model, please upload this below (only 1 file can be uploaded here - with a limit of 5MB per file and with one of the following the extensions: .gif, .jpeg, .png, .bmp, .txt, .doc, .docx, .xls, .xlsx, .ppt, .pptx, .pdf):
Business model
Please answer some questions on the business model of your deployed ITS application.

Your ITS application/product/service deployed is provided as:

☐ B2B (Business to Business)
☐ B2C (Business to Consumer)
☐ Both (e.g. TMC massages being issued through own user channel and via B2B channel)
☐ I don’t know

Your ITS application/product/service deployed is:

☐ a stand-alone product/service
☐ a complementary product/service
☐ provided as a part of product/service bundle
☐ a public good provided by government or other road operator or infrastructure manager (e.g. traffic control provided via VMS or traveller information services operated by public entities)
☐ I don’t know

The stand-alone ITS application/product/service deployed is provided as:

☐ Free of charge
☐ One-time payment
☐ Time based subscription
☐ Usage-based fees
☐ I don’t know

The complementary ITS application/product/service deployed is:

☐ offered free of charge to a customer when another product is purchased
☐ offered for extra charge to a customer when another product is purchased (e.g. a driver assistance system offered as an option with a vehicle for a defined price)

Please indicate the main product the ITS application/product/service is offered with:

Your deployed ITS application/product/service is financed:
☐ through usage fees or sales revenues
☐ through European funding
☐ through national, regional or local public funding
☐ by advertising revenue
☐ through a public private partnership (provided by a consortium of stakeholders with a mutual PPP agreement)
☐ by a business model involving a two-sided market (e.g. platform economy and some payment systems)
☐ monetization of user generated data (e.g. Facebook, some instances of floating mobile data)
☐ I don’t know
☐ Other

Do you have more best-practices/business models you can share?
☐ No, I do not have any more best-practices/business models.
☐ Yes, I want to add one more best-practice/business model.

For the next best-practice case/business model - Please describe your best-practice case or business model other ITS practitioners can learn of:
Great - than let's get in direct contact! Please send me your information directly to katharina.zwick@austriatech.at or leave me your e-mail address that I can contact you.

SPECIFIC TRAINING NEEDS

Specific training needs and main interests for training
CAPITAL project will design training tailored to the specific needs and existing know-how gaps. The following questions will help CAPITAL to evaluate different types and key areas for trainings.

Please indicate your MAIN AREAS OF INTEREST for trainings (select max.4):

☐ General introduction on the topics
☐ Financing and funding opportunities
☐ Evaluation methods and cost benefit analysis of ITS services
☐ Best-practice cases
☐ Legal issues
☐ Business models
☐ Procurement models
☐ Relevant technologies and standards
☐ I am not interested in a training

Please indicate in which TYPE OF TRAININGS you are interested in (more than one answer possible):

☐ Online courses
☐ Participation in webinars to very specific topics
☐ On-site visits
☐ Get training material (as flyers, folders and handbooks, etc)
☐ Participation in workshops / face-to-face trainings (organised by public authorities)
☐ Participation in workshops/ face-to-face trainings (organised by industry)
☐ Participation in workshops/ face-to-face trainings (organised by research institutions)
☐ I am not interested in a training
FURTHER INFORMATION

Would you like to be informed on upcoming CAPITAL project activities and results or would you be interested to participate actively in CAPITAL project activities (e.g. participation in workshops, trainings)?

☐ Yes, I would like to have further information on the project activities (newsletter, etc)
☐ Yes, I would like to participate actively
☐ Yes, both
☐ No

CONTACT INFORMATION

Please leave your contact data for further information:

Name: __________________________________________
Organisation: ______________________________________
Email address: _____________________________________

Thank you for your willingness to share and exchange your expertise!
Your input provided by answering this questionnaire will form valid basis for further activities.

Thank you for your support!
We appreciate your valuable assistance!
5.2 Interview guidelines

INTERVIEW GUIDLINE
ON CAPITAL TASK 2.2.: PRIORITIES AND TRAINING NEEDS FOR ITS

This guideline contains guiding questions for in-depth, structured interviews with key stakeholders from the different CAPITAL communities. The guideline is designed for personal interviews or telephone interviews. Furthermore it could be helpful to send out the questions to the interviewees in advance for preparation:

CAPITAL functional distinction of CAPITAL communities according to D.2.1.:

- **Public authorities** including national authorities, local/regional authorities (cities, provinces, regions), transport authorities, road administrations
- **Transport operators** (e.g. road operators, public transport operators) and **fleet owners** (for passengers and freight)
- **Professional end-users/professional drivers**: are the “end-users” that can be reached by the platform. Professional end-users (e.g. truck drivers) will be reached in the project. But end-users – meant as private persons and the general public – will not be in the direct focus of CAPITAL's training activities
- **Suppliers** (can be public as well as private) include technology suppliers, industry platforms, data and transport service related providers
- **Knowledge providers** include universities and research institutions, expert groups, related platforms and associations (e.g. ITS associations, user associations), certification bodies (even if these are public authorities that act as knowledge providers in the context of the project)
- **Dissemination partners** are those stakeholders, not directly involved as trainers, trainees or content providers for the training programs, but have an important role in dissemination and awareness for the CAPITAL project and training programs.

**Interviewees**

Public authorities and transport operators and fleet owners, as well as the expert groups and related platforms (as part of the knowledge providers) were already targeted with a specific 2.2. questionnaire. Only a low number of additional interviews will be conducted with these groups to complement the information received by the questionnaire and to have an in-depth look on their expectations and opinions (and collect additional key stakeholders).

The needs and views of the suppliers, as well as the universities and research institutions (as not explicitly targeted by the questionnaire so far) will be investigated through the interviews. As they are not targeted as trainees, but only for know-how exchange and participation in the trainings, a low number of interviews will be sufficient in order to obtain the (training) needs and know-how gaps, as well as their view on priorities and barriers.
The role of the different communities (excerpt from D.2.1.)

Main groups for training (“trainees”) within CAPITAL will be predominantly public authorities followed by transport operators and fleet owners and professional end-users. Suppliers and knowledge providers will be involved for exchange and knowledge transfer between the groups, but will not be trained themselves in the framework of CAPITAL.

In general CAPITAL is based on a peer-to-peer training concept, combined with the principle of knowledge transfer and exchange between different groups. So e.g. experts from the group of the public authorities will also act as trainers for other public authorities.

INTRODUCTION

About the project: The aim of the CAPITAL (Collaborative cApacity Programme on ITS Training-educAtion and Liaison) is to build a collaborative capacity community and deployment programme to support public and private stakeholders in the implementation of ITS (C-ITS) with training and educational resources which enable knowledge transfer about the benefits and deployment of ITS. The project will assist public and private stakeholders in developing their knowledge, skills, and abilities to build technical, business and policy making proficiency of ITS deployment while furthering their professional development.

Aim of the interview/context questionnaire: CAPITAL designed a web-based questionnaire for public authorities, transport operators, transport related service operators, ITS Associations and ITS experts, with different levels of know-how. The main goal of this web-based questionnaire was to identify most crucial deployment priorities of ITS from the view of the public sector, best-practices cases as well as major challenges that hinder further ITS deployment. At the same time the online questionnaire aimed to identify the current level of already existing ITS expertise as well as know-how gaps in different topics, which will help CAPITAL to assess specific training needs and priorities. Building on this information CAPITAL is to develop tailor-made supporting training modules and materials.

In addition, the guidelines provided in this document are designed for in-depth interviews that help to get a more detailed insight on the needs of the different CAPITAL stakeholder communities and to obtain the needs of those groups not explicitly targeted by the questionnaire.
PUBLIC AUTHORITIES, TRANSPORT OPERATORS AND FLEET OWNERS

Priorities and barriers:

- What are the current priorities for ITS deployment from your point of view in your country/region/city?
- Assessment on the results so far (only if the first results are already available – a short presentation/fact sheet of first results could be prepared as a separate document): What do you think on the results so far? Do you agree with the assessment of the priority topics? Do you miss any additional topics that have not been mentioned so far?
- Talking about your/the identified deployment priorities, are there major barriers or challenges that you can see as hindering factors for the deployment?/ What do you see as the major barriers/challenges in the deployment of ITS?

Specific questions on training (as to be designed within CAPITAL):

- From your point of view – what are the main needs for training (that would help public authorities/transport operators/fleet owners to deploy ITS)? (if necessary -> these are the examples for main areas of interest that are included in the questionnaire: General introduction on the topics, Financing and funding opportunities, Evaluation methods and cost benefit analysis of ITS services, Best-practice cases, Legal issues, Business models, Procurement models, Relevant technologies and standards)
- What type of trainings should be offered (e.g. Online courses, webinars on specific topics, On-site visits, training material (as flyers, folders and handbooks, etc.), workshops / face-to-face trainings)?
- If you are in favour of workshops/face-to-face trainings – who should organise/present in the workshops? Public authorities, industry or research institutions?
- What do you think on the peer-to-peer learning concept (as described in the introduction part -> e.g. public authorities train other public authorities)? Do you agree with the principle or do you see any obstacles? Or should professional trainers act as trainers in CAPITAL?

Participation as trainer:

- Would you like to participate in trainings?
  - If yes, in which trainings/on which topics?
  - What is the main reason for you to participate in this training?
- Can you imagine participating as a trainer?
  - If yes, in which areas you would like to be a trainer?

Additional input on key stakeholders:

- What are key stakeholders that should be actively involved in CAPITAL trainings (because they have so many experience/know-how, will attract a huge audience, are pioneers in their field of activity, etc.)?

KNOWLEDGE PROVIDERS: UNIVERSITIES AND RESEARCH INSTITUTIONS

Priorities:

- What are the current priorities for ITS deployment from your point of view (in general or more specific in your country/region/city)?
• Assessment on the results so far (only if the first results are already available – a short presentation/fact sheet of first results could be prepared as a separate document): What do you think on the results so far? Do you agree with the assessment of the priority topics? Do you miss any additional topics that have not been mentioned so far?

• Are these priority topics you mentioned/that are obvious from the results so far already covered by university courses and trainings?

• What is needed for training considering the current priorities?

• What can be covered by CAPITAL trainings and what needs to be covered on university/academia level?

**Barriers:**

• What do you see as the major barriers/challenges in the deployment of ITS?

• Based on these barriers: Is there something CAPITAL can do to reduce these barriers (with specific training/interaction of the stakeholders)?

• Where is training needed to reduce these barriers?

• What kind of training is needed?

• What can be covered on university level and what has to be addressed on another level (e.g. on political level, budget level, etc)

**Specific questions on training (as to be designed within CAPITAL):**

• From your point of view: What are – in general - the main interests for training for the CAPITAL trainee community (public authorities, transport operators, fleet owners, professional end-user as truck drivers)? (if necessary - these are the examples for main areas of interest that are included in the questionnaire: General introduction on the topics, Financing and funding opportunities, Evaluation methods and cost benefit analysis of ITS services, Best-practice cases, Legal issues, Business models, Procurement models, Relevant technologies and standards)

• Optional (if it fits within the interview):
  o From your experience with training and learning: What type of trainings should be offered as part of CAPITAL (e.g. Online courses, Participation in webinars to very specific topics, On-site visits, Get training material (as flyers, folders and handbooks, etc), Participation in workshops / face-to-face trainings)?
  o From your experience with training and learning: What do you think on the peer-to-peer learning concept (as described in the introduction part -> e.g. public authorities train other public authorities)? Do you agree with the principle or do you see any obstacles? Or should professional trainers act as trainers in CAPITAL?

**Participation as trainer:**

• Would you like to participate in trainings for know-how exchange?

• Can you imagine participating as a trainer?
  o If yes, in which areas/topics you would like to be a trainer?

**Additional input on key stakeholders:**

• What are key stakeholders that should be actively involved in CAPITAL trainings (because they have so many experience/know-how, will attract a huge audience, are pioneers in their field of activity, etc.)?
5.3 Self-assessment template

**PROJECT SELF-ASSESSMENT OF NEEDS**

1. **PARTNER NAME:**

2. **WHAT KIND OF EXPERTISE CAN YOU CONTRIBUTE, THAT CAN BE USED IN THE TRAINING:**

3. **WHAT KIND OF BEST PRACTICES OF ITS (C-ITS) DEPLOYMENT/BUSINESS MODELS DO YOU WANT TO SHARE WITHIN CAPITAL THAT YOU CONSIDER INTERESTING FOR OTHERS:**

4. **WHAT KIND OF NEEDS FOR TRAINING DO YOU SEE IN YOUR COUNTRY:**

5. **WHAT KIND OF EXISTING DOCUMENTS, STUDIES AND PROJECTS DO YOU KNOW ABOUT THAT WILL BE A GOOD STARTING POINT FOR THE STATUS QUO AND NEEDS EVALUATION:**