TEAM

Tomorrow's Elastic Adaptive Mobility

D1.0 TEAM users, stakeholders and use cases

Part A

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Table of contents

List of figures

List of tables

Preamble: The TEAM project

Before introducing the document "TEAM users, stakeholders and use cases", we provide a brief outline of the TEAM project as this document is the first public deliverable of the integrated project TEAM.

TEAM stands for Tomorrow's Elastic Adaptive Mobility". It aims at developing systems for participants in transportation networks, which help them to behave better – by explicitly taking into account the needs and constraints of other participants and the network itself.

Focus will be placed upon decision-making in a time interval above what is commonly associated with reactive safety (typically less than 5 seconds) and below long-term planning applications (typically 5 minutes and longer). In this interval, human actors can employ modern technology to collaboratively devise socially optimal strategies. Thereby, we believe TEAM will be able to reduce the social cost of traffic while increasing its efficiency and flexibility.

The project is built around four basic themes:

1. Basic technologies to realise collaborative mobility: We will advance communication technologies that underpin V2X by integrating LTE technologies, and by developing an automotive cloud-computing platform to support advanced and decentralised traffic management algorithms. This theme is specifically addressed in the sub-project EMPOWER (SP2).

2. Infrastructure-centric technologies and algorithms for elastic mobility: We will develop proactive infrastructure-centric algorithms and technologies to enable behavioural change in order to improve transportation networks in a way that takes into account real-time needs and constraints of all network users. This theme is specifically addressed in the sub-project FLEX (SP3).

3. Distributed technologies and algorithms to realise elastic mobility: We will develop proactive user-, community- and group-centric algorithms and technologies to achieve (and complement) the goals of theme 2. The vision is to use nomadic devices such as smartphones or on-board units to realise massively distributed collaborative control and optimisation concepts. This theme is specifically addressed in the sub-project DIALOGUE (SP4).

4. Demonstration: The success of the project will be demonstrated and validated via innovative leading-edge cooperative applications and a Europe-wide mobility experiment to illustrate the systems' benefits in a pan-European setting. Validation activities, test analysis and user demonstration will be specifically addressed in sub-project EVALUATION (SP5).

The project duration is four years. It has started in November 2013 as a joint initiative of 27 partners, ranging from Automotive OEMs, tier-one suppliers, smartphone and mobile services providers, traffic managers, research institutes and others.

Summary

This document outlines the results of the first phase of the TEAM project. The deliverable D1.0 Users, stakeholders and use cases has been divided into four documents (Part A, B, C, and D). This document constitutes part A of the Deliverable D1.0 and serves as an umbrella to the three other parts of the deliverable D1.0 as shown in Figure 0.1.

D1.0 in general outlines the results of the work packages (WPs) WP22, WP32 and WP42. All these WPs ran in parallel, started with the kick-off of the TEAM project and have parallel tasks, addressing the relevant topics associated with the according sub-project. These WPs discuss relevant users, stakeholders and use cases and thus set the basis to the future work within TEAM, and in particular within the three sub-projects EMPOWER (SP2), FLEX (SP3) and DIALOGUE (SP4).

The main common objective is to define the applications (in WP32 and WP42) or - respectively - the basic technologies (in WP22) and their use cases, which will be analysed in detail within the TEAM project.

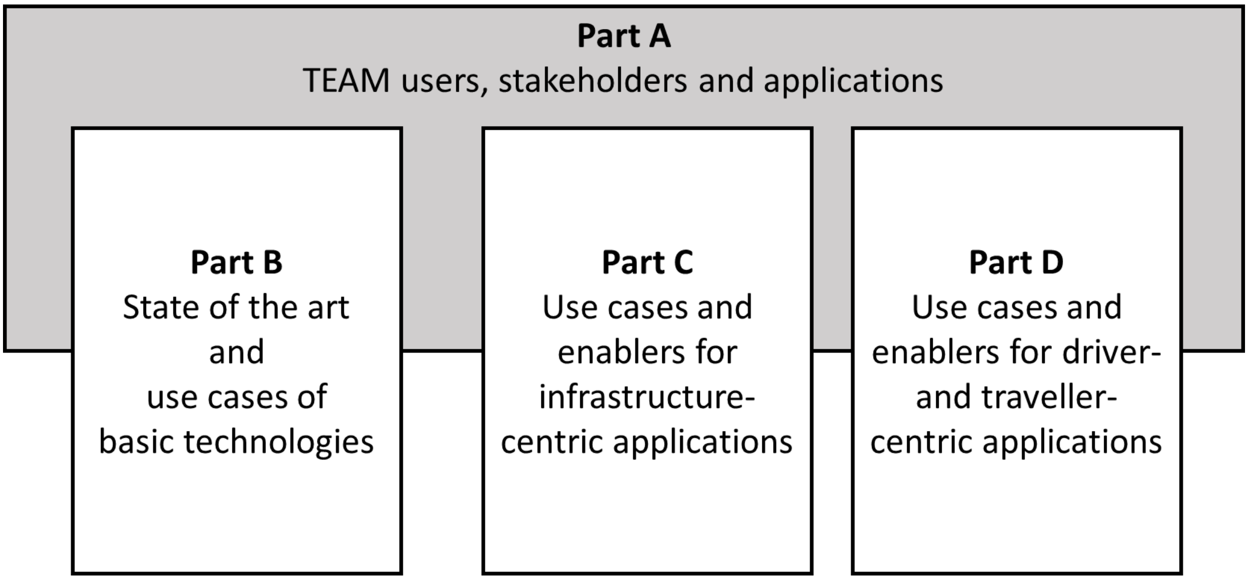


Figure 0.1: Four parts (A-D) define D1.0 TEAM users, stakeholders and use cases.

Consequently, the description of applications, basic technologies and use cases is the main part of D1.0. As these descriptions are provided in great technical detail, the valuable recommendation of reviewers have been taken into account and this detailed analysis and description has been shifted to extra documents (Part B, Part C and Part D).

As the deliverable D1.0 documents also the start of the project, it includes some basic definitions and assumptions, on which the TEAM partners agreed - they are included in part A. Examples for such terms are "applications", "use cases" or "enablers". As these three terms play an important role in the work, they are described here too: applications cause a system to perform useful tasks, which are recognizable to the end user. The term is used in contrast to enablers, which manage and integrate capabilities but do not directly perform tasks that benefit the user. The enablers serve the applications - which in turn serve users. Applications have one or multiple use cases that correspond to features of the application, which could be experienced by the end user. Figure 0.2 – it is discussed below – visualizes the key idea here.

A meaningful selection of the most important terms is included in the introductory chapter of this document. Besides, it is outlined how this work shall be used within further steps of the project.

One of the main challenges of the work done so far has been the selection and agreement of applications, use cases and enablers, which will be addressed and further analysed in detail within the project. This selection has a deep impact on the future work of the consortium. Therefore, partners implemented an assessment and evaluation methodology to get a selection, which satisfies multiple constraints and interests. Examples for those evaluation dimensions are the suitable technical challenge associated to the development of an application, the state of the art of technologies (such that the TEAM project guarantees to go beyond today's development), the suitability to the basic character of the TEAM project and last but not least stakeholder interests. This selection process is outlined in Chapter 2 of this document.

As a result the following applications have been selected:

- Collaborative adaptive cruise control
- Collaborative eco-friendly parking
- Collaborative driving and merging
- Green, safe and collaborative driving serious game and community building
- Collaborative eco-friendly navigation
- Collaborative pro-active urban/inter-urban monitoring and ad-hoc control
- Collaborative co-modal route planning
- Co-modal coaching with support from virtual/avatar users
- Collaborative smart intersection for intelligent priorities

- Collaborative public transport optimization
- Collaborative dynamic corridors

Besides application development, one of the cornerstones of TEAM is the development of basic technologies to support the applications. The main objective of the EMPOWER sub-project is to develop such basic technologies to be used by FLEX and DIALOGUE applications. TEAM aims at advancing such technologies beyond the state of the art. That includes several components such as communication convergence, positioning accuracy, mapping, privacy and security – the work basically addresses technology components that belong to the *Facilities* layer we know from standardisation bodies and related research projects. In this sense, the sub-project will provide the basic building blocks for the TEAM system. At the same time, the partners choose four main themes that will be addressed within the project with particular focus:

- Communication technologies
- Local Dynamic Map++ (LDM++) and automotive cloud
- Cooperative positioning
- Security and privacy

According to these four main themes, four groups of partners have been set up, where each group – the so-called TECH groups – focussed on one of these themes. The first one is communication convergence, which will evaluate how short range communication (802.11p) can be integrated with the latest cellular data communication (LTE) techniques to provide seamless communication to the applications. The second area in focus is dynamic maps, starting from the existing LDM (Local Dynamic Map) concept. The TEAM project wishes to advance this concept and will create a LDM++ including cloud technologies and respecting lessons learned. The third topic is cooperative positioning, which will investigate different methods for improving both relative and absolute positions to reach lane level accuracy. The fourth subject includes privacy, security and reliability for the complete system.

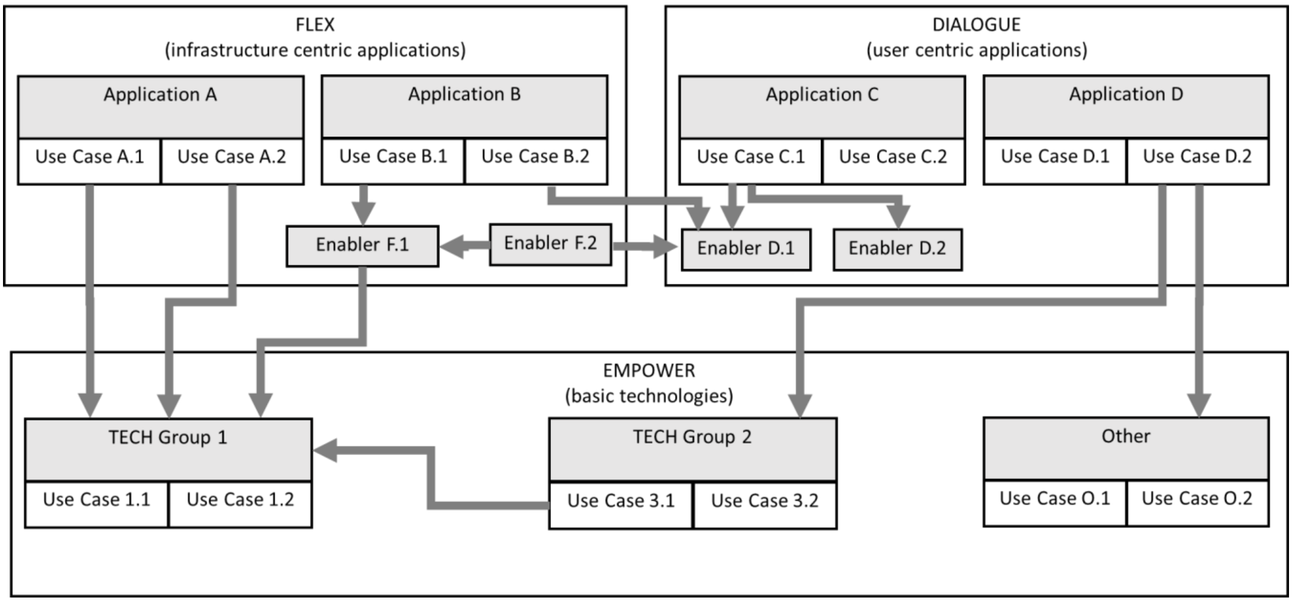


Figure 0.2: Figure illustrating general relationships between sub-projects, applications, enablers, use cases and TECH groups.

The partners have performed a state of the art survey for the TECH group topics to identify current trends and weaknesses of given solutions. Starting from here, TEAM defined how to advance from this point with relevant innovations – considering stakeholder needs at the same time. This work was done by collecting use cases per technology focus. We assume, that one application has one or multiple use cases, which correspond to technological features. These may make use of features from other basic technologies. The applications' (associated to the sub-project FLEX or DIALOGUE as described below) use cases use functionalities of enablers; these do not necessarily need to belong to the same sub-project.

Figure 0.2 shall summarize the basic idea of the approach with applications, use cases, enablers, basic technologies (which are mainly represented by TECH groups) and sub-projects. It shows that the work performed in the EMPOWER sub-project (in this context WP22) provides the (technological) basis to the work in FLEX (here WP32) and DIALOGUE (here WP42). The TECH groups work on the advancements beyond the state of the art regarding the basic (empowering) technologies. Equivalent to applications, we assume that each basic technology has one or more use cases.

It must be noted, that Figure 0.2 does not picture an architecture and not even an architecture draft.

The TECH groups are organized in a matrix format as illustrated in Figure 0.3. The horizontal perspective comprises the different ITS subsystems where these technologies will be integrated. These ITS subsystems are the vehicle, roadside, central and personal subsystems.

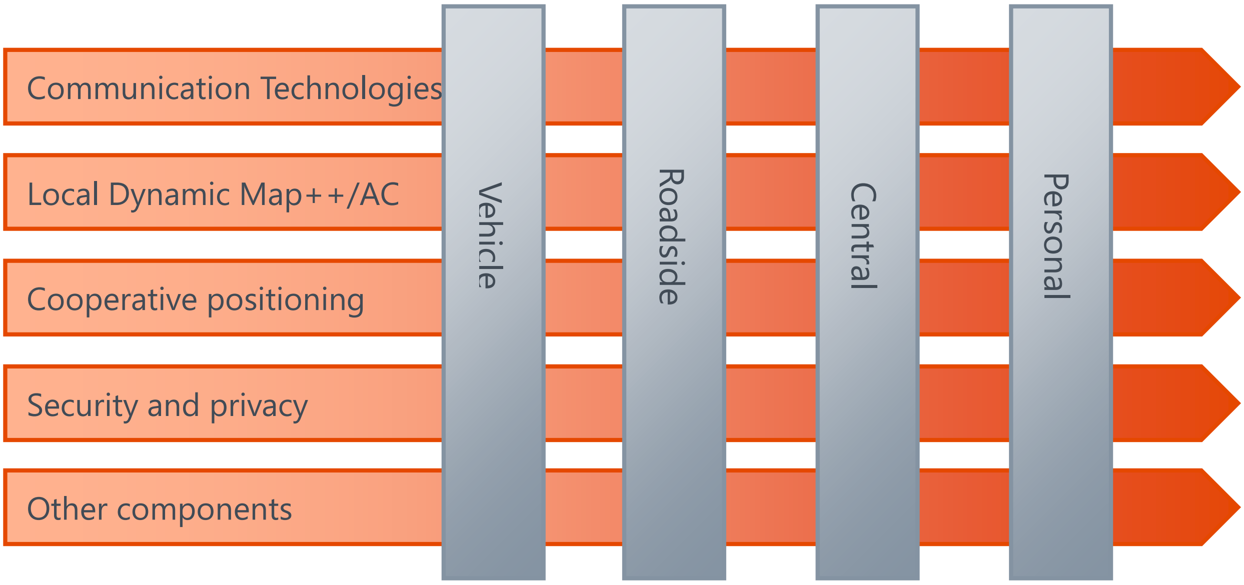


Figure 0.3: Applications and enablers in a draft TEAM ITS Station architecture

The basic technologies and according use cases serve the applications and the enablers, which are developed in the sub-project FLEX and DIALOGUE. We divided the list of selected applications into infrastructure-centric applications (addressed in sub-project FLEX) and driver or traveller-centric applications (targeted in sub-project DIALOGUE) as depicted in Table 0.1.

Table 0.1: TEAM application associated with TEAM sub-projects FLEX and DIALOGUE.

FLEX Applications	DIALOGUE applications
• Collaborative pro-active urban/inter-urban monitoring and ad-hoc control • Collaborative co-modal route planning • Co-modal coaching with support from virtual/avatar users • Collaborative smart intersection for intelligent priorities	• Collaborative adaptive cruise control • Collaborative eco-friendly parking • Collaborative driving and merging • Green, safe and collaborative driving serious game and community building • Collaborative eco-friendly navigation

• Collaborative public transport optimization • Collaborative dynamic corridors	

The FLEX sub-project aims at flexible energy efficient and eco-friendly mobility from the infrastructure's side based on interactions between all relevant users (i.e. travellers, vehicles, infrastructures). The key concept in FLEX is "elastic" transport infrastructures, that is infrastructures, such as parking places, road lanes and public transport. The TEAM developments will help to make these more flexible and make them change based on citizens' or cities' demand. In this document, the stakeholders' views with regards to such infrastructure-centric applications and enablers as well as their specific characteristics, preferences and constraints are presented as a result of an online survey. The result of the survey is valuable and will be used in the next phases of the project. In brief, it can be stated that users are rather ego-centric and want the best for themselves while local authorities want the best for the system/community. Public transport operators, road operators, logistics providers, etc. are mainly focused on their own profit and their customers' benefits. Traffic management centres, finally, have to build the missing link between all of them and to find strategies such that all constraints and preferences are fulfilled as much as possible.

Equivalent to the in-detail description of basic technologies targeted in the EMPOWER document (Part B of D1.0), we describe FLEX applications and their relevant use cases in detail based on a common template agreed by the consortium in Part C of D1.0. A lot of information about the required components, the input and output data and possible challenges of the applications and their use cases were highlighted. Finally, a first draft list of enablers and enabling use cases were provided. This list will be enhanced and fixed in the specifications' phase, based on the outcome of the discussions not only internally in FLEX but in close cooperation with the sub-projects EMPOWER and DIALOGUE.

The work performed in the DIALOGUE sub-project is equivalent to the work performed within the FLEX sub-project. DIALOGUE intends to prove a set of driver and traveller-centric applications based on collaborative mobility. The latter extends cooperative mobility by adding major concepts of driver- and traveller-in-the-loop, of road usage negotiation and social networking, for a safe, sustainable and efficient mobility. This is reflected by the set of applications addressed, see Table 0.1. The continuity with intelligent transportation roadmap is also clear: almost all applications are strongly related to existing in-vehicle systems, such as collaborative ACC, eco-friendly parking, driving and merging applications, and eco-friendly navigation. Overall, these applications are an enhancement of ITS state of the art with the collaborative nature of TEAM. As such they are strongly relying on real-time feedbacks among all entities, posing several requirements on technologies such as LTE and ITS-G5, enriched LDM (LDM++), HMI, as well as on the integration of these technologies into the vehicle systems. A major aspect emerging from this analysis is the need of accurate data from the environment, as well as the challenge of managing and retrieving these data, either locally (e.g. low latency V2V applications, ego-vehicle sensors, etc.) or in the cloud (download of data thanks to broadband connectivity) or both. Especially for cloud-based functions, a combination with FLEX functionalities has to be evaluated. That is also in line with the basic technologies targeted in the EMPOWER sub-project. The application green, safe and collaborative driving serious game and community building deserves a separate mention, being one of the main novelties as well as one of the core features of DIALOGUE, addressing both coaching, and team and community awareness. This explains the need to define a large set of use cases for its definition, and additional functions of community management. Beyond the application itself, an important aspect to be carefully investigated is the integration of this application with other ones, considering the right trade-off between driving freedom and constraints in combined scenarios, e.g. where a game competition is on-going and an application like C-ACC or CDM advises the multitude of vehicles to keep a certain behaviour. The solution has to be found on the one hand within the gaming application by defining proper rules for team collaboration, on the other hand within DIALOGUE by fostering from the beginning a joint design, with integration and orchestration of the applications. In-detail description of these applications are found in Part D of D1.0.

The deliverable D1.0 is a joint deliverable of the three sub-projects. The joint nature helped to integrate the different actions in the three sub-projects. Even though the deliverable shows that not all statements and expectations are perfectly aligned over all the partners, the cooperative work of the many involved and contributing partners helped to develop a common view on the project. This outcome of the work is probably as important as the document itself with all the application and use case descriptions.

One of the main challenges of the work done has been the selection and agreement of topics (here applications, use cases, enablers, basic technologies), which will be addressed and further analysed in detail within the project. This selection has a deep impact on the future work of the consortium.

1 Introduction

This chapter provides a short overview on the document. It provides an introduction on the overall motivation and objectives, the methodology and application selection. Finally, we outline the integration of the work in the TEAM project and the structure of the document.

1.1 Motivation and objectives

This deliverable documents the work performed in WP22, WP32 and WP42. The scope of the all three work packages targets mainly two points: (1) stakeholders and selection of applications and (2) definition of use cases, applications and enablers[1]. The first point is addressed in this document. The second point in the Parts B, C and D.

The WPs are responsible to identify the stakeholders and users of all enabling technologies (WP22) and applications (WP32, WP42) in the TEAM context. Stakeholders and users were contacted to analyse their interests, needs, concerns and constraints in order to reflect them properly in the work for the TEAM project. That means that it is ensured that TEAM's enabling technologies and applications are not only taking into account project specific considerations but also statements of stakeholders, which are not motivated by project-internal needs.

The identified stakeholders' needs are collected. These needs target basic technologies, applications and use cases directly, but are also needs inferred from applications in regard to basic technologies. That shows that the work in the three work packages and the three sub-projects is closely connected. Therefore, one format to describe use cases and applications has been applied in all three sub-projects.

Moreover, the document includes an update of the state of the art survey performed during the project proposal, which ensures that latest developments are respected and taken into account. Main focus here is put on basic technologies.

In parallel to the description of state of the art work and use cases, which were collected from stakeholder surveys and literature review, one central objective of the work packages has been to define the future key topics of the overall TEAM project. These are – at least partially – defined by the applications and use cases selected. Thus, the selection of use cases and applications, but also enablers and basic technologies are one of the main outcomes of the work packages and will be input to subsequent work in TEAM.

[1] The terms "applications", "use cases" and "enablers" are introduced in the following subsection.

1.2 Methodology

The main scope of the relevant work packages has been the selection of applications, enablers, use cases and basic technologies, which will be further analysed and developed in the TEAM project. A key aspect here has been to consider the stakeholder interests in the selection process.

Basic terms and relationships are shortly discussed hereafter. Figure 1.1 supports the following descriptions visually.

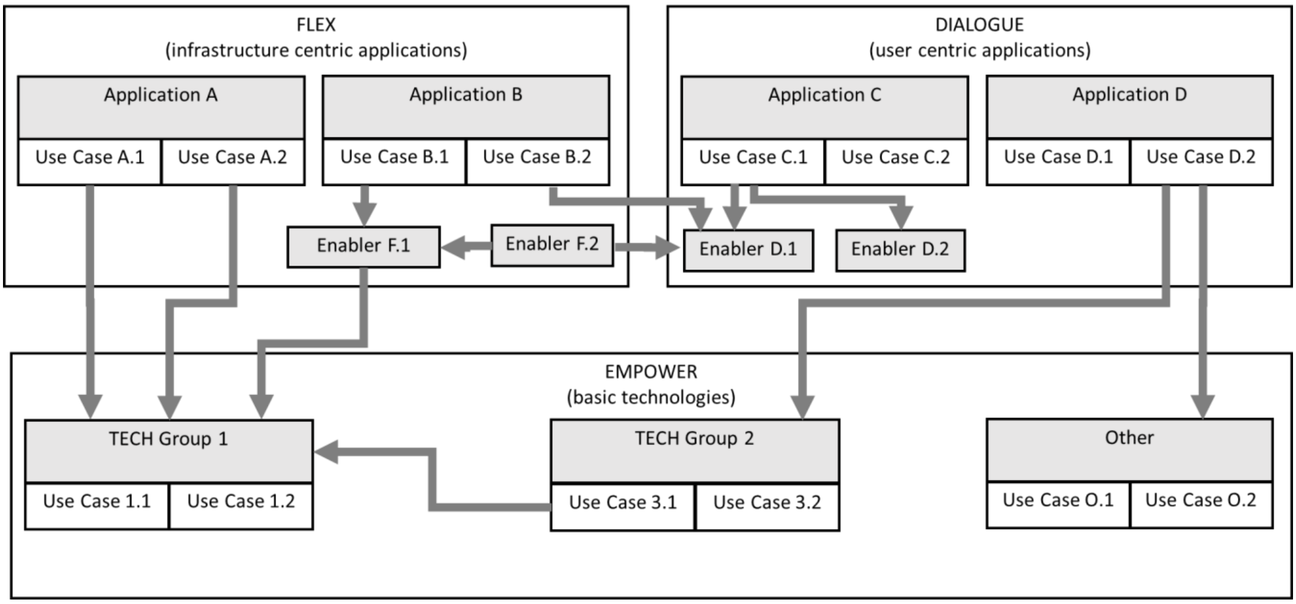


Figure 1.1: Figure illustrating general relationships between sub-projects, applications, enablers, use cases and TECH groups.

1.2.1 Basic technologies

One of the cornerstones of TEAM is the development of so-called basic technologies to support the applications. In the sub-project EMPOWER several features will be developed such as communication convergence, positioning accuracy, mapping, privacy and security. In this sense, the sub-project will provide the basic building blocks – or basic technologies - for the TEAM system deployed on infrastructure systems and mobile systems (Vehicle ITS Stations, smartphones). Looking at known ITS architecture stacks, basic technologies are related to all components (HW or SW) from the Facilities layer and below.

1.2.2 Applications and use cases

The TEAM project will focus on eleven applications. Generally speaking, we assume that an application causes a system to perform useful tasks which are recognizable to the end user. The term is used in contrast to system software or enablers, which manage and integrate computer's capabilities but do not directly perform tasks that benefit the user. The enablers serve the applications, which in turn serve the user.

Those applications, where stakeholders are mainly from the infrastructure (city authorities, traffic management centres, public transport operators, etc.) are developed within the sub-project FLEX. These are:

- Collaborative pro-active urban/inter-urban monitoring and ad-hoc control
- Collaborative co-modal route planning
- Co-modal coaching with support from virtual/avatar users
- Collaborative smart intersection for intelligent priorities
- Collaborative public transport optimization, and
- Collaborative dynamic corridors.

The work here is discussed in Part C in detail.

Applications, where stakeholders are mainly from the automotive industry, end user service providers etc. are developed in sub-project DIALOGUE. These applications are:

- Collaborative adaptive cruise control
- Collaborative eco-friendly parking
- Collaborative driving and merging
- Green, safe and collaborative driving serious game and community building, and
- Collaborative eco-friendly navigation.

The work here is discussed in Part D in detail.

The customer or end user of applications is the driver or traveller. The traveller refers to mobile citizens, which use other means of transport than personal cars. Examples for that are public transport users, passengers of vehicles, bicycle riders, or even pedestrians. Vehicles refer to cars, motorbikes, electric vehicles, trucks, hybrids etc.

Next to applications, there is the concept of use cases. It is assumed, that one application has one or multiple use cases, which correspond to features of the application, which could be experienced by the end user. According to Wikipedia a use case "…is defining interactions between a role (known in UML as an "actor") and a system [here the TEAM application], to achieve a goal. The actor can be a human or an external system."[2]

Description templates for applications and use cases were developed and applied. The filled templates state the main contents of the Parts B, C and D.

1.2.3 Enablers

The concept of enablers will play a significant role in TEAM. The term "enabler" is used for data or aggregated data, tools and algorithms to be used by the applications. Enablers serve multiple applications, which in turn serve the user. Enablers are invisible to the end user.

Figure 1.2 illustrates the relationships between applications, use cases and enablers. The figure is based the stack known from related ITS projects (such as DRIVE C2X). The basic technologies include facilities, network, transport & OS and access layer.

The user interacts with applications via applications' use cases. Not only users interact with applications via use cases but also other applications or some external systems in general. Use cases are illustrated with help of orange arrows. The applications require and access services from the enablers. Again, the particular interaction is a use case (illustrated with an arrow). Enablers may interact with each other.

Within TEAM, we developed the idea of enablers early on. In the process of application description, we asked relevant partners to propose enablers, which might support relevant applications. It must be stated, that the list of enablers is an early collection of proposals and far from a final list of enabling components. The given list (the interested reader is referred to Sections 4.4 and 5.4) will be processed to get to such a stage in the next phase of the project.

As soon as there is are requirements and specification of enablers available, the catalogue of generic enablers of the FiWare project[3] is reviewed. Since there are partners involved in both project (among others the coordinator Fraunhofer FOKUS) a non-formal collaboration has already been established.

[2] Compare to Wikipedia on use cases, http://en.wikipedia.org/wiki/Use_case
[3] Project website www.fi-ware.eu

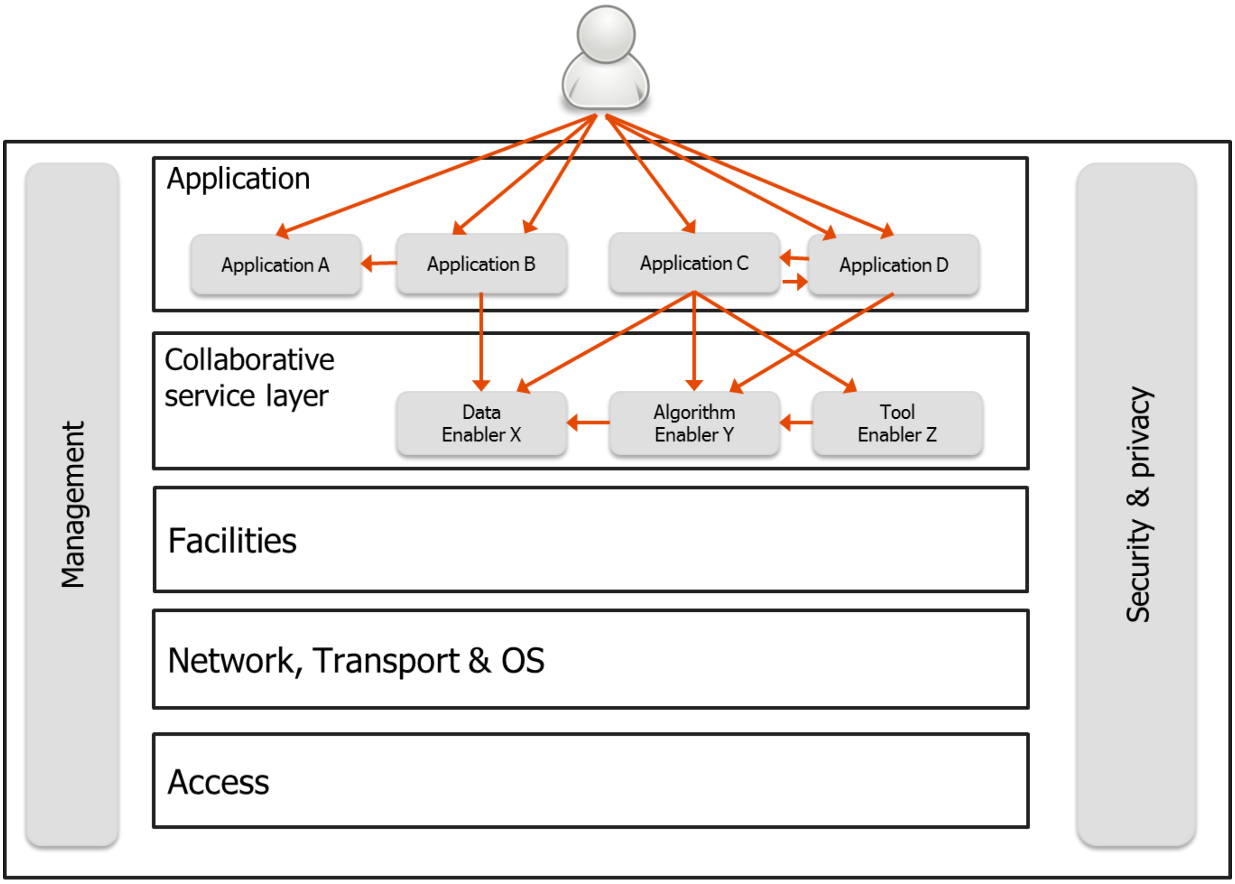


Figure 1.2: Applications and enablers in a draft TEAM ITS Station architecture. The basic technologies include facilities, network, transport & OS and access layer.

1.3 Application selection

One of the main tasks in the early phase of the project has been the selection of applications, which will be of interest for the TEAM project. The main idea of the selection process is shown in Figure 1.3. Starting with a broad collection of mobility applications collected from partners, stakeholders and relevant research projects, the process shortened the list by assessing the general suitability of the application in regard to the TEAM idea ("TEAM Character"), and then by assessing technical aspects and more general stakeholder-related criteria.

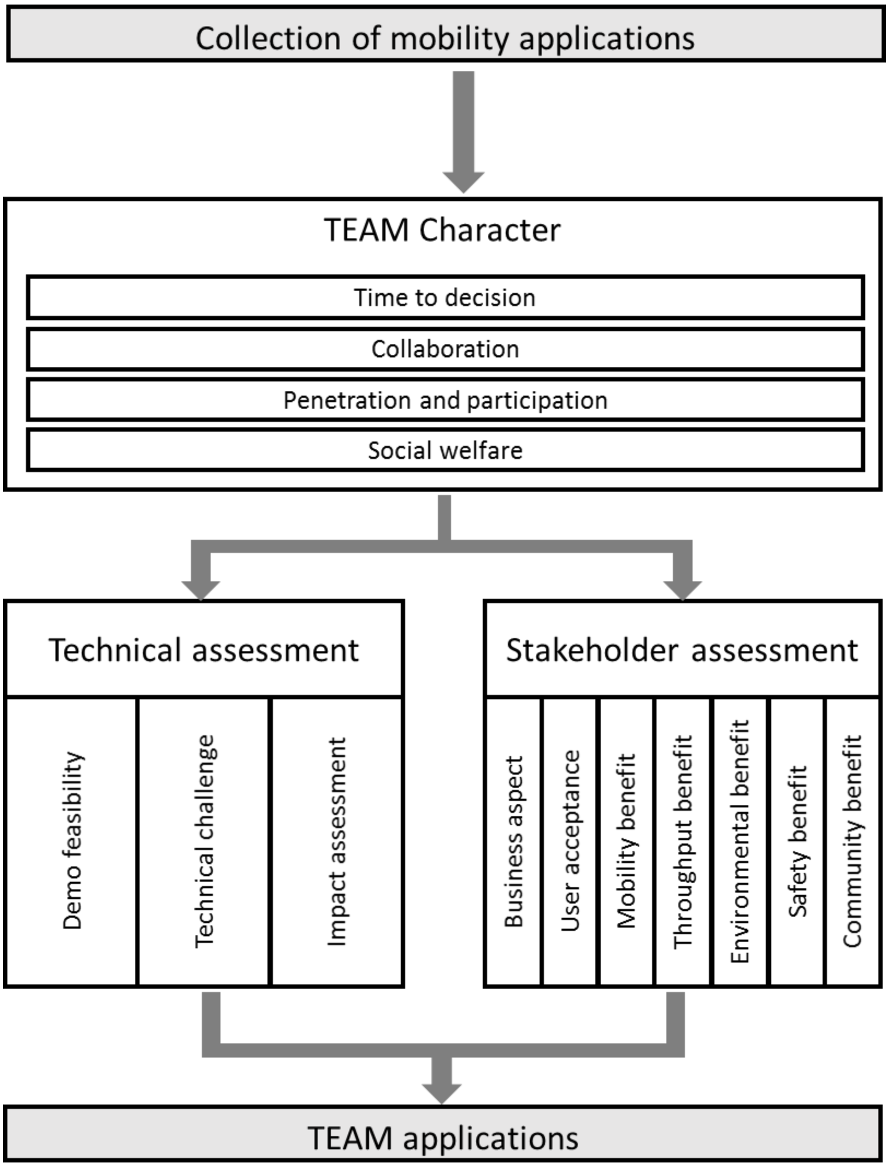


Figure 1.3: Basic idea of the TEAM application selection process

The scope of this selection process and evaluation methodology is to come to a selection, which satisfies multiple constraints and interests. This selection process is outlined in Chapter 2 of the deliverable.

1.4 Project integration

The D1.0 outlines major parts of the start-up phase of the project and its result. It is a joint deliverable D1.0 (Part A-D) from the sub-projects EMPOWER, FLEX, DIALOGUE and – to some extend – the sub-project EVALUATION, which addresses basic technologies and application assessment and impact assessment.

The TEAM project is organized in a way, that these three sub-project have parallel tasks and joint milestones to support integration. That means that the sub-projects have equivalent (and sub-sequently organized) work packages. And all three started with the work package "Users, stakeholders, and use cases" (WP22, WP32, and WP42), see Figure 1.4.

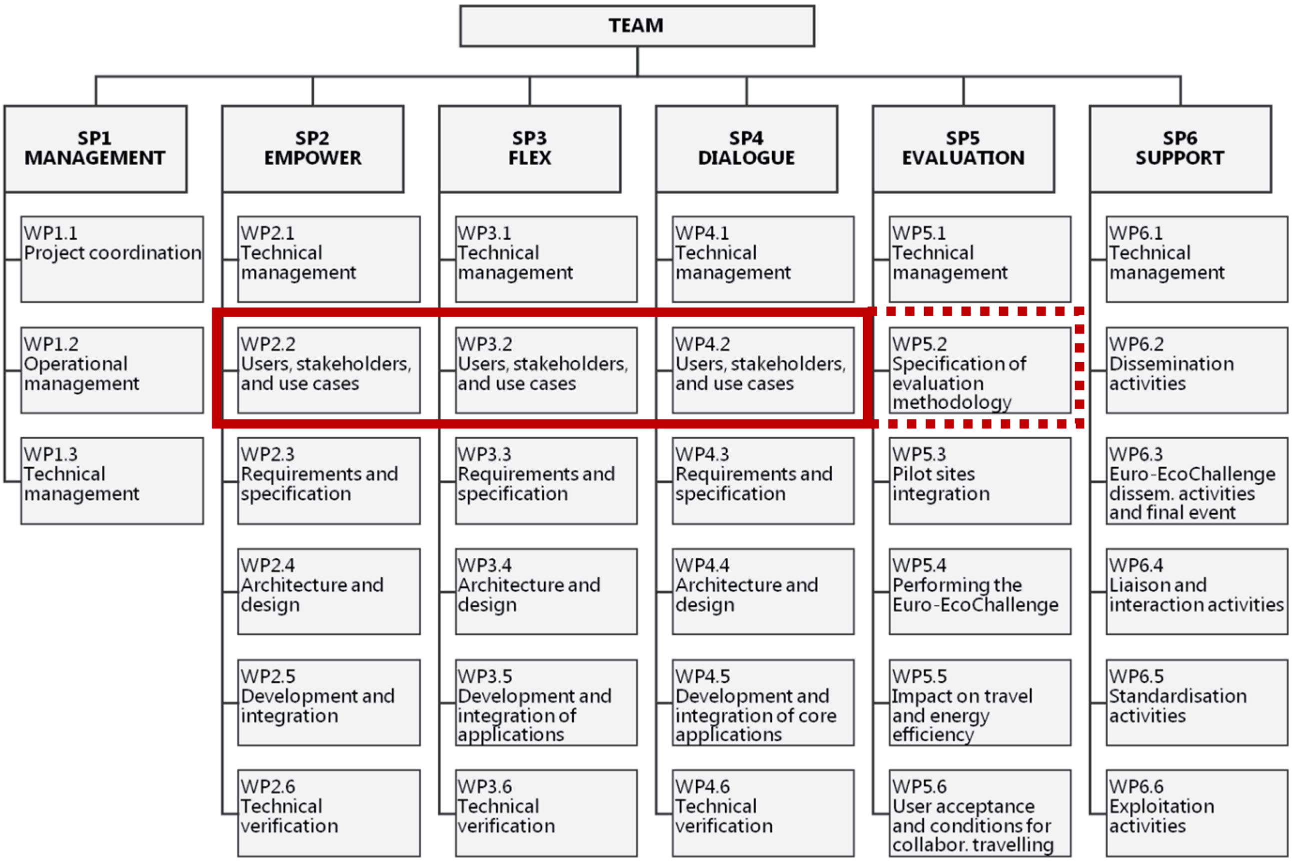


Figure 1.4: Work breakdown structure

The main task during this phase of the project has been to agree on the key topics of TEAM. This has been done by selecting applications, enablers and basic technologies.

The application and use case description templates took into account the strong relationships and interdependencies between the sub-projects (as indicated in Figure 1.1), such that the document serves as a starting point for the requirements analysis – especially cross-sub-project requirements.

Main contributors of the deliverable were the partners involved in the work packages WP22, WP32, and WP42. In order to take into account the evaluators perspective right from the beginning, partners from WP52 monitored and commented the work performed. The work regarding the stakeholder survey has partly been driven by those.

The document is a fundamental part in the project as it is the outcome of the first step in the project, where important decisions were taken: especially the decision which applications and basic technologies will be (further) developed in TEAM.

The document serves as input to the next stage in the project. In particular that includes the requirements analysis in WP23, WP33, and WP43 as well as the system architecture in WP24, WP34, and WP44.

1.5 Structure of the document

Based on the valuable feedback of evaluators, the intial extensiovbe document was split into four parts – mainly because the initial (joint) document got very extensive. The main reason is the description of application and use cases. These parts were shifted to the part B, C and D of deliverable D1.0. That underlines the idea, that these parts should be understood as technical reference documents.

The structure of the document is as follows: in the following Chapter 2, the application evaluation and selection process is described and closed with the result.

In Chapter 3 stakeholders are discussed starting from a basic technology perspective. The chapter discusses also the test site point of view and highlights the technological challenges identified with help of the survey.

Chapter 4 describes the stakeholders from the SP3 perspective in detail. Survey results were not evaluated but relevant information were provided from partners with industry expertise.

Chapter 5 describes the stakeholders in the context of the sub-project 4. Results from the survey are discussed.

The document closes with a conclusion in Chapter 6.

2 Description of selection process and introduction to survey

This chapter introduces the process how the project selected the applications of interest for the TEAM project. Besides, it introduces the applications considered in the selection process and the outcome – the list of application, which shall investigated in detail in TEAM. The process is a three step approach: (1) Collect potential applications from other projects and partner proposals, (2) filter those application that suit the general TEAM idea, and (3) assessment and ranking of applications with project-specific criteria (e.g. technical feasibility) and project-independent criteria (e.g. expected environmental impact). The complete process is visualized in Figure 1.3.

2.1 TEAM character in ITS applications

Within this subsection, we introduce the first step that was performed to select the applications of interest. In the first step, the consortium collected a broad list of application from various sources. That included reports from the following projects:

- DRIVE C2X[4]
- simTD[5]
- SAFESPOT[6]
- INVENT[7] and AKTIV[8]
- CODIA[9]
- Vehicle Infrastructure Integration

Ongoing projects of interest were mainly the following:

- SPITS[10]
- eCoMove[11]

[4] http://www.drive-c2x.eu
[5] http://www.simtd.de
[6] http://www.safespot-eu.org/
[7] http://www.invent-online.de
[8] http://www.aktiv-online.org/
[9] http://www.cvisproject.org/en/links/codia.htm
[10] http://www.cvisproject.org/en/news/spits_the_strategic_platform_for_intelligent_traffic_systems.htm
[11] http://www.ecomove-project.eu/

- INTIME[12]
- iTETRIS[13]
- citylog[14]

Besides, the consortium contributed with additional application proposals that were discussed in joint sessions.

In order to prune down the broad list of potential applications, the second step in the selection process is the assessment of applications against the basic idea of TEAM. The TEAM character is defined (among other dimensions) by some features, that are true for all TEAM's applications. These are the following:

Time to decision

One feature of all applications relevant for TEAM is, that they support the decision-making in a particular time interval, which is between five seconds and five minutes. That means that TEAM does not target typical reactive safety applications (where the time-to-decision is typically less than 5 seconds). At the same time, TEAM does not target long time planning applications, where the time to decision is typically 5 minutes and longer. In the relevant interval between 5 seconds and 5 minutes human actors can employ modern technology to collaboratively devise socially optimal strategies. Thus, we assess collected applications regarding the question whether they address decisions that are within such a time interval.

Collaboration

The TEAM project assumes that collaboration is the key concept towards enhanced and environmentally aware mobility for all citizens, building on cooperative systems, reliable real-time data, and on active participation of all network actors. TEAM brings the idea of cooperative traffic ahead by joining travellers and infrastructure operators in a collaborative network to solve various travel needs all the way from eco-friendly parking to short-term decisions on trip planning. Collaboration is the key concept of the TEAM approach, which extends the cooperative concept of the first generation systems and applications, by integrating the human user in a highly integrated cooperative, interactive, and participatory network. In this collaborative concept, there are not only the technical systems that communicate (automatically), but all actors (systems and humans) are engaged in a continuous bi-directional, dynamic exchange of information. The outcome of

[12] http://www.in-time-project.eu/
[13] http://www.ict-itetris.eu/
[14] http://www.city-log.eu/

collaboration is joint strategies. Thus, we wish that relevant applications go beyond the exchange of information and develop aligned actions of mobility.

Stakeholder-Doc: Serious Gaming-Abschnitt erweitern um deutlichere Aussage zu altruistischem Verhalten der Nutzer, Punkt 15

Penetration and Participation

The TEAM concept extends state of the art work towards collaborative and pro-active traffic system management which encourages active participation and interaction of road users through empowering communication and data aggregation technologies. Thus, we assume that one feature of all addressed applications within the TEAM project is that the driver is in the loop and is in control of all (aligned) actions.

Social welfare

TEAM aims at developing systems for participants in transportation networks, which help them to behave better – that means by explicitly taking into account the needs and constraints of other participants and the network itself, when decisions are made. In consequence, TEAM applications should not only benefit the individual user but also – and to some extend more importantly within the TEAM context – the community and increase the social welfare.

Having these features in mind, the consortium removed those applications from the list, which could not be characterized by the above features. The applications which remained are the following 19:

1. Collaborative ACC

The assumption is that vehicles shall communicate with other vehicles and infrastructure and share position and speed information, mostly via smartphones running the framework. In addition, traffic data information from the cloud server is available per road segment and can be combined with information from other users in a specific area of interest. This information can be used to extend the foresight range of ACC Systems (Adaptive Cruise Control) in order to predict the traffic density ahead and adjust ACC speed accordingly, ultimately improving traffic flow.

2. Collaborative parking

This application's objective is to enable connected vehicles to access real time information about parking availability in the surrounding area of the destination. Vehicles are connected to a cloud service informing individual road users (vehicle drivers and others equipped with devices) with data about available parking spots. The application can function in a very simple press-a-button-way or automatically detect the users parking searching context by referring to the destination from navigation system, favorites, POIs or daily commuting habits. Motion detectors and collaborative sensing on-vehicles allow vehicles to detect "fitting" parking spots. Also, virtual coins (from gaming) could be used to get a parking spot indicated which suits the drivers preferences. In a first implementation a remote dynamic map (in the cloud) of free parking slots (addresses and number of free slots) can be asked on demand or offered around navigation destination.

3. Driving and merging

This application aims at controlling safety and improving energy efficiency. It refers to the case where two or more vehicles need to interact for driving in specific situations. The application addresses the challenges in the collaboration among the vehicles. The most representative use case is lane change or lane merging; other relevant situations include roundabout driving, emergency braking or hazardous situation in front, intersection start and stop, highway entrance or exit and speed limit adaptation.

4. Serious gaming (for drivers and travellers)

The goal of the application is to promote proper driver behaviour by providing a contest environment where drivers can have challenges based on green and safe driving. Exploiting information and data from the collaborative TEAM application, the application consists of a "gamified" map-based social environment where drivers and passengers can share their information and learn proper driving styles in a pleasant and compelling way. The application will be available to the user through the internet on smartphones (also on PCs, where available). While the user is driving, the application – connected to a database storing real-time vehicle signals (e.g., from the vehicle network) – processes data about the travel in real-time. The user interface will be very simple and configurable by the user, limited to a very simple feedback about the current level of performance by the driver (e.g. a 3-colour traffic-light, or a performance meter). Each user will be able to insert geo-referenced messages inside the social map environment when the vehicle is not moving. Incentives are foreseen in terms of virtual gadgets/facilities and of real-world rewards such as access to pool lanes, discounts for parking costs, free bus tickets, etc. From a technical point of view, the SG-CB is a TEAM meta-application, in the sense that it exploits data communicated by the other applications in order to support good user behaviour.

5. Collaborative eco-friendly navigation

This application merges the application user's individual preferences and constraints with the needs of other drivers, travellers and traffic systems to create collaborative eco-friendly navigation for all road users. It is a turn-by-turn navigation application running on smartphones and vehicle-integrated platforms. This application provides the interface to the user while he is driving, monitors the user's behaviour and triggers new route calculations (in case the driver behaves differently to the instructions or if traffic conditions have changed). The application takes into account static traffic data, personalized routing, adaptive routing as well as Vehicle-to-X (V2X) and/or communicating smartphone apps. The information provided by the driver is collected in a central or infrastructural server which calculates routes for every TEAM user optimizing the overall benefit.

6. Collaborative pro-active inter-urban monitoring and ad-hoc control

By the help of this application TEAM equipped vehicles can monitor urban roads and recognize incidents or special events while driving. This system is based on the information exchange between the Vehicle-API as a monitoring sensor and the proactive TMC through V2I communication. Being able to receive data from various other data sources (e.g. crowd sourcing, mobile devices, data providers, public authorities), the feature applies algorithms for reliable network status forecast. The dynamic information can be used in real-time to coordinate collaborative traffic control and reduce congestion, fuel consumption and consequently emissions level.

7. Collaborative co-modal route planning

COPLAN will provide collaborative multi-modal route planning by fusing and aggregating information coming from multiple FLEX and DIALOGUE applications. These include heterogeneous data from the *Collaborative pro-active urban/inter-urban Monitoring and Ad-Hoc Control application* such as pollution sensor data and traffic density as well as information from third parties relevant to real-time and future road incidents. Other sources from which information can be collected can be: Public Safety Answering Points (PSAP), Municipality services, road operators and historical traffic related data gathered from TEAM users. Based on this information, the application will provide end-users with alternative routes and transportation modes based on user-centric info (e.g. origin and destination, departure time, user preferences, etc.). Additionally, the TEAM system may come up with a co-modal route, e.g. a new bus line from A->B or a car-sharing option.

8. Co-modal coaching with support from avatar

This is a co-modal app with post trip cost/benefit analysis functionalities, made through a comparison of the behaviours of the real user and the "virtual" avatar user. The proposed idea does not aim on vague pre-trip forecasts but reliable and exact post-trip information about realized trip alternatives a user would have had for the same origin-destination pair including monitoring and displaying their true costs, travel times and CO2 emissions based on real-time knowledge about occurred traffic jams or delays in public transport, private transport etc. A comparison will be made through real time monitoring the individual route of a user and the encountered trip alternatives of an avatar travelling by optimal transport modes from the same origin to the same destination at mostly the same time. Platforms implementing the application include smartphones/Vehicle-APIs as well as TMCs.

9. Collaborative smart intersection for intelligent priorities

The goal of *Collaborative smart intersection* is to have fully collaborative intersections that can dynamically optimize the general traffic flow and especially public transport. The application is based on the exchange of information between smartphones, Vehicle-APIs, TMCs and road side units. Measures include giving priority to certain vehicles, i.e. buses, while at the same time taking into account the current traffic conditions, as well as the communication and synchronization of multiple traffic lights in a region. Vehicles will receive a speed recommendation in order to get to the next traffic light in green as well as smart start-stop and braking recommendations. Additionally, the application includes start and stop functionality based on information that comes from smart and pro-active Road side units (RSU).

10. Collaborative public transport optimization

The goal of this application is to increase the flexibility of the transport infrastructure by adapting it to the demands and needs of cities and citizens. The main focus lies on buses but the application can be extended to other means of transportation. It functions by analyzing input from travellers that is transmitted via smartphone (positions, destination, departure time, selected bus route, etc.), traffic information (current road situation) and public transportation timetables. On the basis of this input the system will work towards both short term and long term bus scheduling optimization (accident or traffic based route adaptation, adding and/or skipping bus stops, headway adaptation, etc.) and provide pre-trip and en-trip information to the traveller.

11. Collaborative dynamic corridors

This application puts into action the concept of transport corridors with an intelligent transportation system (ITS) perspective. The main objective is to establish corridors for heavy vehicles like trucks or buses in a dynamic way meaning that certain lanes can be reserved for certain vehicles during a certain period, depending on the traffic conditions and priorities. Intelligent access control makes it possible for authorities to easily and effectively control the access for individual vehicles to certain areas or corridors: Vehicles should identify themselves and give information about size and weight. It should be possible for authorities and stakeholders to monitor for compliance to rules and regulations. Another feature of the *Dynamic Corridors* application is the possibility for dynamic vehicles to adapt to local regulations, e.g. low noise zones where vehicles can choose different strategies to fulfil the regulation that allow them to enter the area. Additionally, there is the possibility of connecting this app with the *Cooperative Driving's merging feature* which can help the drivers of heavy vehicles to access the corridor lanes and drivers could be motivated by serious games to improve their behaviour in order to increase their priority in accessing those lanes.

12. Overtaking vehicle warning

This application tries to secure one of the commonest dangerous situations that occur in normal highway traffic: the overtaking/passing maneuver. An overtaking (passing) vehicle signals its action to the vehicle being overtaken to secure the situation. The OBU of the overtaking car detects the upcoming or current overtaking process and sends a notification message to the car which is going to be overtaken. The OBU of the car being overtaken receives the overtaking message and decides whether the driver should be informed via HMI.

13. Intersection collision warning

This application informs and warns driver in case of a potential collision with crossing vehicles. Each OBU transmits required information about its own vehicle status to other vehicles including position, velocity, heading, etc. Each onboard unit collects all information received from relevant vehicles in coverage and its own vehicle data. The OBU/Safety Computer determines the risk of a collision by real-time calculation. The application will improve driving comfort and safety by increasing the likelihood of drivers being aware of potentially dangerous situations at intersections.

14. Traffic information and recommended itinerary

This application recommends a route for the vehicles navigation system which should lead the driver around congested locations. The monitoring authority predicts increase and decrease of traffic by tracking common traffic dynamics (e.g., flow changes by non-C2X traffic participants) inputted via any available sensors or site surveillance and monitoring facilities. The authority is then able to exert control and optimize the traffic flow by suggesting a route for the vehicle requesting this service. The driver may or may not comply with the itinerary recommendations provided.

15. Co-operative flexible lane allocation

This application considers the flexible allocation of a dedicated lane (e.g., reserved to public transport) to some vehicles which get a permanent or temporary access right. If the traffic flow is slow and an additional lane is available for restricted usage certain cars could be prompted to use the lane in order to improve traffic flow. The drivers then get a message from the Human-Machine-Interface (HMI) to change the lane. The targeted vehicles are equipped with necessary devices to receive information from the road side unit, or relaying information from other vehicles. The driver benefits from an optimized travel time and the public authority achieves a better traffic flow and less pollution by avoiding traffic jams.

16. V2I Traffic Optimization

The Vehicle to Infrastructure V2I Traffic Optimization optimizes traffic flow by intelligently applying regulations to the road side infrastructure. In this application traffic information collected from enabled Onboard Units (OBU) are utilized to control road side infrastructure like, e.g., traffic lights, speed advisory and speed limiting gantries, etc. The system basically receives simple heartbeats as Cooperate-Awareness messages from the OBUs and calculates road utilization and computes rules or events for the connected road side infrastructure (e.g., setting suitable speed limits to better distribute vehicles along segments of the monitored strip) so that the driver can reacts upon the notifications.

17. Co-operative adaptive cruise control

This application informs the driver via device about the conditions along his further route. The On-board units (OBU) – sensors are responsible for obtaining conditions (acceleration, vehicle's speed, and distance to vehicle in front of the ego vehicle) from vehicle sensors. Using this application a group of vehicles may use measures retrieved from other vehicles to choose to cooperatively drive in a group of vehicles on the same road in the same direction with the same speed with minimal distance between the vehicles (platooning). The benefits are reduced air pollution and thus reduced fuel consumption. The overall traffic benefits from an increased road capacity due to the reduced distances of the co-operatively driving vehicles.

18. Co-operative vehicle-highway automation system (platoon)

The Co-operative vehicle-highway automation system (platoon) offers automated positional and velocity control of vehicles that can operate as a platoon on a highway. The On-board unit (OBU) functions as a Platoon Message Sender and Receiver (bidirectional) and provides for automated speed adjustment and safe following of the platoon leader. This application tries to establish a smoother traffic flow and enhances the safety on highways. It aims to provide both lateral and longitudinal (velocity) control of vehicles in order to operate safely as a platoon on a highway based on communicating vehicles. Based on C2C- and C2I communication, with additional sensor backup (radar, camera), the system reduces fuel consumption.

19. Electronic toll collect

By using this application a car can pay the road toll electronically via OBU-RSU communication without stopping which replaces the toll booth. The RSU identifies the individual car and sends vehicle information to a central toll service and confirms the payment process. The OBU in the car provides (identification) information about the individual vehicle to the RSU. The drivers are informed about the price and linked conditions. They have to identify themselves to the OBU since bank accounts are linked to people and not to cars. This function can be used for other drive-through payment situations.

That means we identified 19 applications contributed from partners and collected from on-going and previous projects, which comply with the TEAM characteristics.

2.2 Technical selection criteria

In the second step, we asked selected experts from the consortium to evaluate these 19 applications, which were identified in the previous section, with help of the criteria demo-feasibility, technical challenge, and impact assessment. These criteria are of a technical nature and should help to assess the suitability to implement, demonstrate and assess selected applications within a joint research project like TEAM. In the following, these criteria are outlined shortly.

Demo-Feasibility

One of the most important success criteria for the TEAM project is a successful presentation of results – especially when applications are implemented and demonstrated in real world environments. The experts were asked to assess this criteria on a scale from zero to ten.

Technical Challenge

Applications were removed from the list, where the consortium will fail with the implementation or demonstration due to technical or financial hurdles. Experts were asked how they assess technological challenges. Experts were asked to assess this criteria on a scale from zero to ten.

To extended by 5 seconds. Real-time capabilities criticiscm

Impact Assessment

In sub-project five applications are evaluated in regard to the benefits, user acceptance, environmental impact, traffic throughput benefits etc. The selected applications should have the character, that such an assessment is possible.

Technical experts assessed all features on a scale from zero to ten. In parallel to this assessment (and ranking), a broader list of stakeholders were asked to assess application not limited to criteria relevant for the TEAM project. Before that, the executed survey is introduced in the following section.

2.3 Introduction to the stakeholder survey

In the TEAM project four Stakeholder Forums will be organised. The workshops take place in the beginning of the project for identifying stakeholders' requirements and preferences, and during the last project year to support evaluation (WP5.6), business modelling and exploitation tasks (WP6.6).

With accordance of the TEAM project management team the first stakeholder workshop is implemented by an online survey in order to approach more experts, a representation of various stakeholder categories and in order to receive better results to work with in the future. Since all SPs are highly interested in the expert ranking on the proposed TEAM applications in order to focus the work on the most relevant applications, one particular focus of the web survey is the assessment and ranking of TEAM applications.

However, also further questions of special interest for the SPs shall be tackled on SP level and under organization of the SP leaders.

The online survey contains three main parts:

- Introduction to TEAM, the TEAM objectives and to the survey purpose
- Presentation of TEAM applications and the ranking criteria
- Additional SP specific questions for Stakeholders

2.3.1 Involved stakeholders

The stakeholders that were approached in the first Stakeholder Forum (SHF) are asked to give their opinion on a set of closed questions in an online survey.

Due to the early stage of the project only TEAM internal stakeholders were approached. Externals will be included in the follow up SHF when first TEAM results can be reported.

Stakeholders from the following categories are included in the survey:

- Automotive OEM

- Automotive suppliers
- Road operator
- Mobile phone and service providers
- Research Institutes and University
- Pilot Sites

The survey was sent to all TEAM partners in order to receive as much feedback as possible. Additionally, special stakeholders have been selected who have agreed on giving thorough feedback on the questionnaire. This stakeholder list includes 26 contacts. The contact persons were not necessarily the ones that answer the questions but they may ask the respective people in their companies or institutions to complete the questions.

2.3.2 Setup of online web survey

In the beginning of the survey, each stakeholder got a written introduction for the survey and a short explanation of TEAM, including the explanation of the ranking process. Additionally, the person should indicate to which stakeholder category he/she belongs and from which company he/she is. The following Figure 2.1 shows the relevant web page of the survey.

It was not planned to ask for personal data since it is not necessary the contact person within the institution who may fill in all questions. However contact addresses are asked from all persons who participated in filling the questionnaire in order to be able to ask back in case of uncertainty in the open answers.

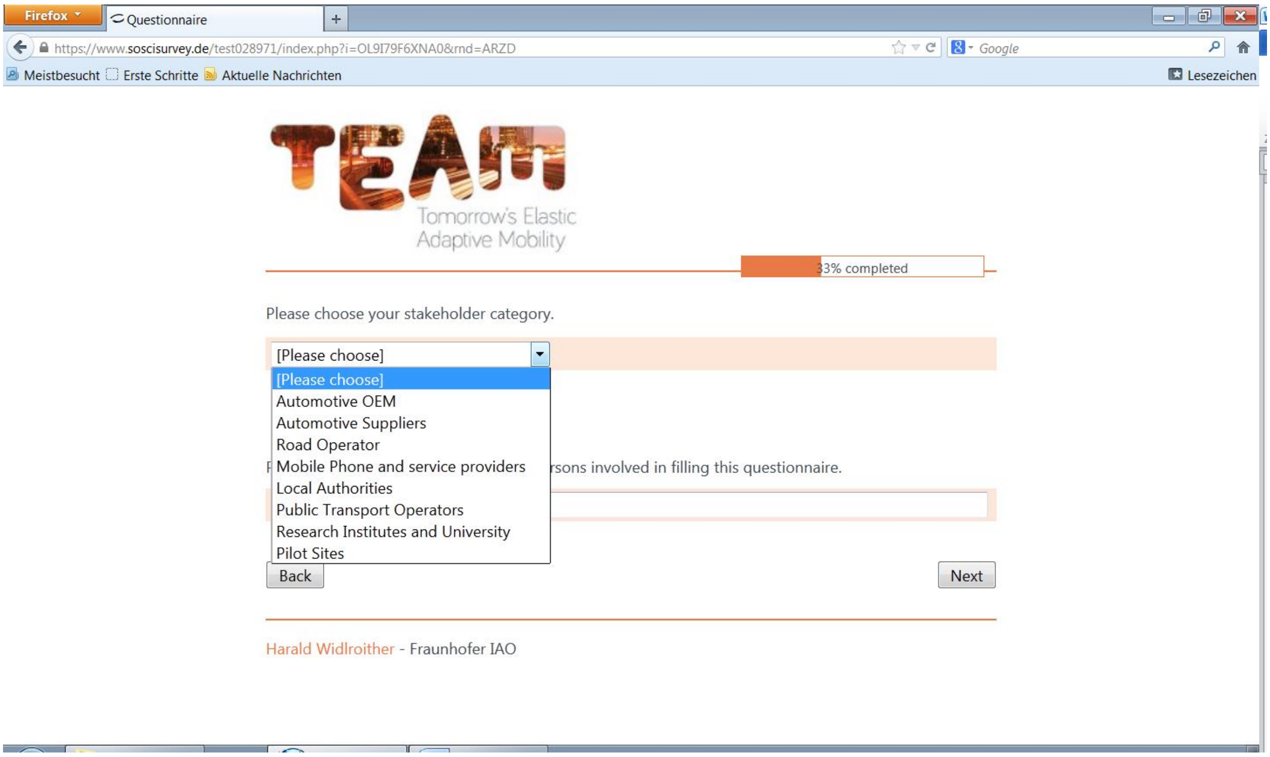


Figure 2.1: Screenshot of the introduction of the web survey

The following introduction was included: “The European research project TEAM is about developing new applications for vehicle-to-vehicle-communication and vehicle-to-infrastructure-communication (V2V/V2X). The TEAM vision is to take the stop from cooperative driving towards collaborative driving, meaning to enable intuitive driver-to-driver communication and support a TEAM-behaviour in traffic and travel situations.

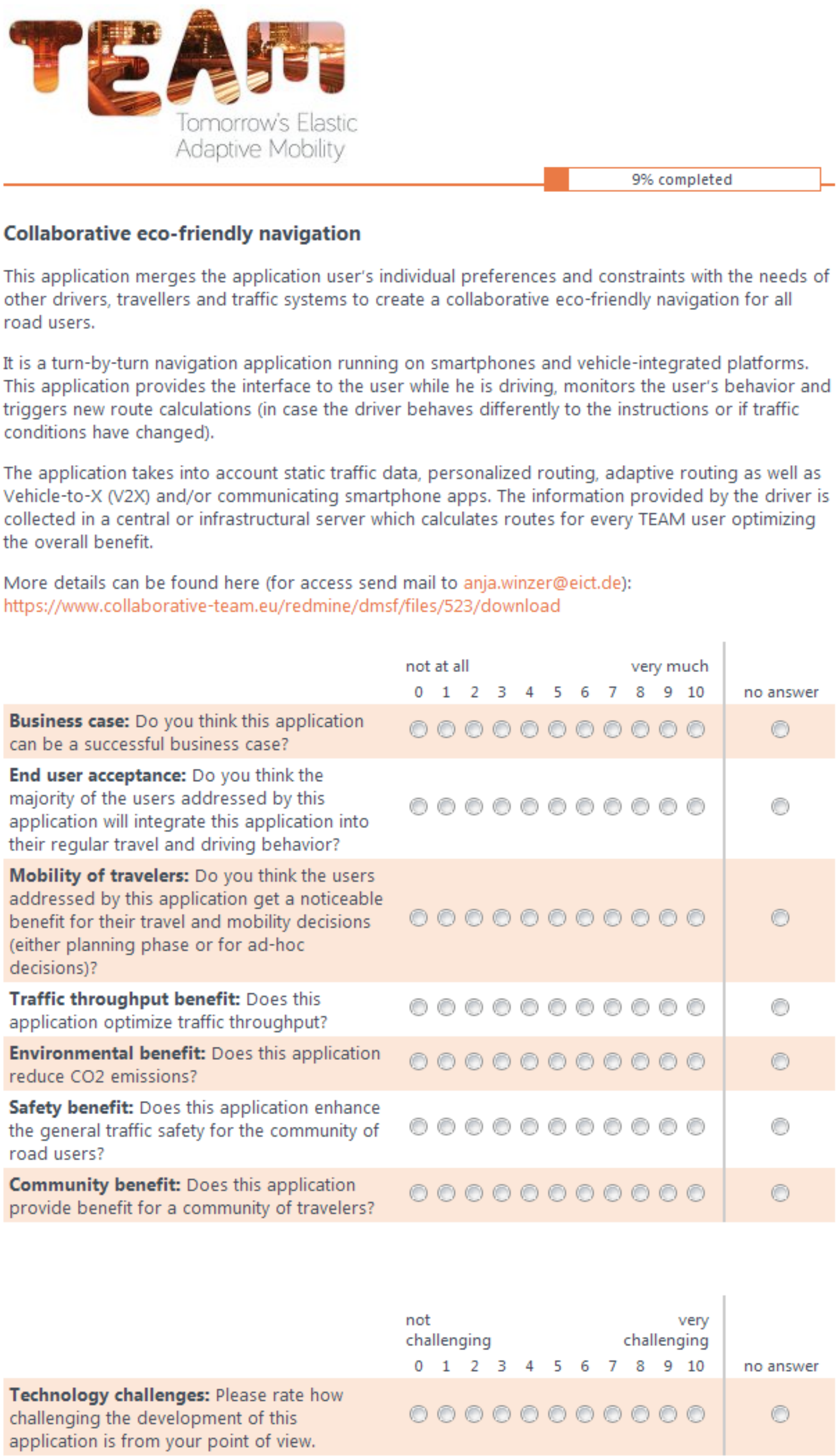
In this survey you will find a set of possible TEAM applications that are possible to realize as prototypes within the project phase. In order to rank and weight the applications we ask you, as an expert and stakeholder in this area, to provide your opinion and answer some questions per application.

You may also ask colleagues to answer some questions or to provide feedback on some of the applications if you think they can answer more specifically.

Any questions can be directed to Anja.Winzer@eict.de . She will forward them to the corresponding person in TEAM to provide you fast and correct feedback. Meanwhile you can continue filling the other questions.”

The survey was designed and planned by TEAM stakeholder forum where each sub-project was represented. The forum was led by EICT GmbH. The survey was carried out as web survey and Fraunhofer IAO was responsible for its technical implementation. Before sending out the survey it was piloted with two separately selected project members. Answering to the survey took approximately two hours and there was possibility to save and continue answering later.

As said earlier, the survey's scope could be divided into two parts: (1) assessment of proposed TEAM applications and (2) sub-project related questions. The following two screenshots Figure 2.2 and Figure 2.3 show one application specific page of the survey incorporating both aspects, here for the Collaborative-friendly navigation application (we have two screenshots of one webpage as the page is vertically long).



TEAM Tomorrow's Elastic Adaptive Mobility

9% completed

Collaborative eco-friendly navigation

This application merges the application user's individual preferences and constraints with the needs of other drivers, travellers and traffic systems to create a collaborative eco-friendly navigation for all road users.

It is a turn-by-turn navigation application running on smartphones and vehicle-integrated platforms. This application provides the interface to the user while he is driving, monitors the user's behavior and triggers new route calculations (in case the driver behaves differently to the instructions or if traffic conditions have changed).

The application takes into account static traffic data, personalized routing, adaptive routing as well as Vehicle-to-X (V2X) and/or communicating smartphone apps. The information provided by the driver is collected in a central or infrastructural server which calculates routes for every TEAM user optimizing the overall benefit.

More details can be found here (for access send mail to anja.winzer@eict.de):
https://www.collaborative-team.eu/redmine/dmsf/files/523/download

	not at all 0	1	2	3	4	5	6	7	8	9	very much 10	no answer
Business case: Do you think this application can be a successful business case?												
End user acceptance: Do you think the majority of the users addressed by this application will integrate this application into their regular travel and driving behavior?												
Mobility of travelers: Do you think the users addressed by this application get a noticeable benefit for their travel and mobility decisions (either planning phase or for ad-hoc decisions)?												
Traffic throughput benefit: Does this application optimize traffic throughput?												
Environmental benefit: Does this application reduce CO2 emissions?												
Safety benefit: Does this application enhance the general traffic safety for the community of road users?												
Community benefit: Does this application provide benefit for a community of travelers?												

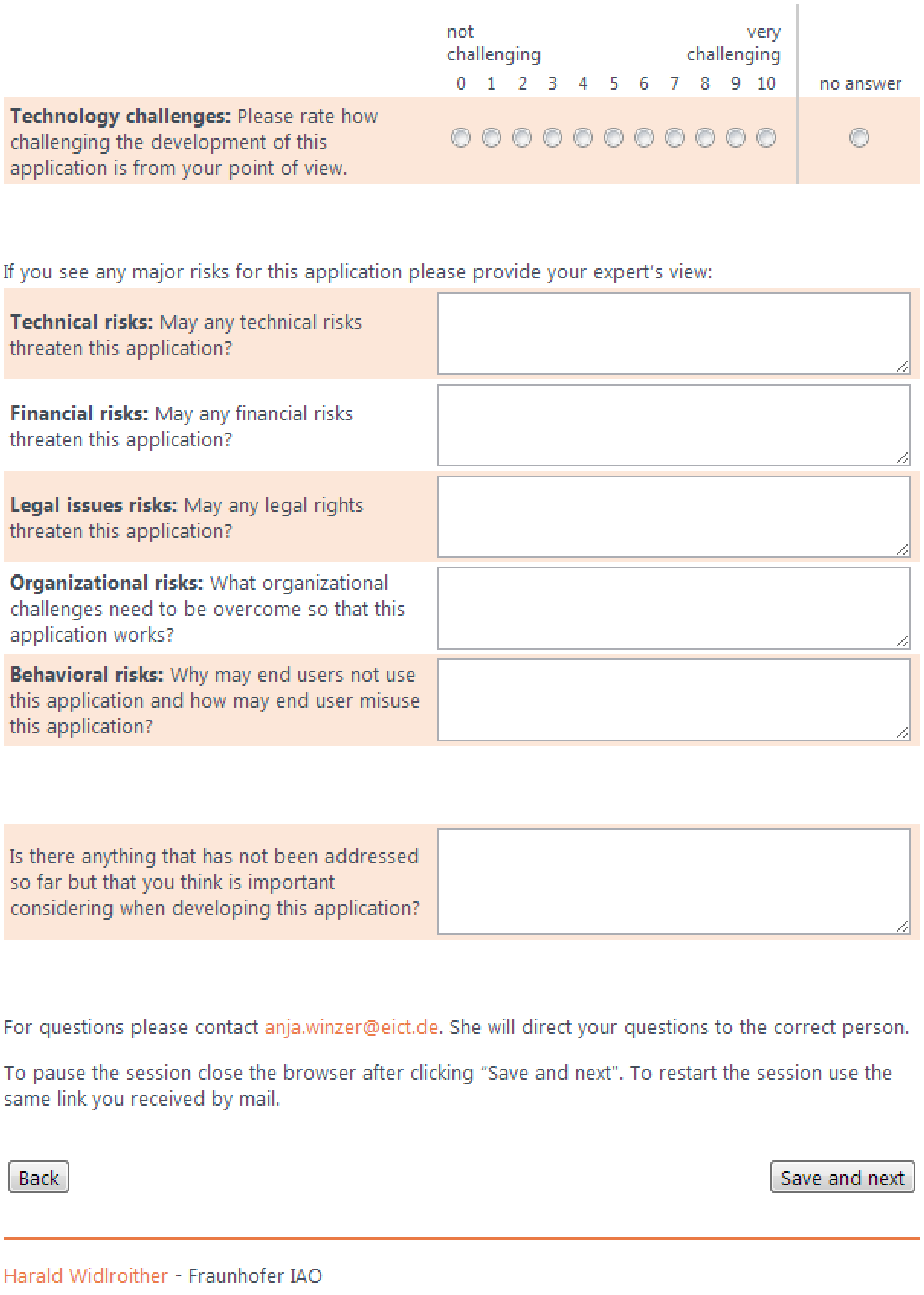
	not challenging 0	1	2	3	4	5	6	7	8	9	very challenging 10	no answer
Technology challenges: Please rate how challenging the development of this application is from your point of view.												

Figure 2.2: Screenshot application centred survey, part one

Figure 2.2 shows the short description of the application and includes a link to additional information. After that the main input for the selection process is shown, which is the same for all 19 applications. As shown in Figure 2.2, the following questions were asked:

- **Business Case:** Do you think this application can be a successful business case?
- **End User Acceptance:** Do you think the majority of the addressed users will integrate this application into their regular travel behaviour?
- **Mobility of travellers:** Do you think the end users get a noticeable benefit for their travel decisions (either planning phase or for ad-hoc decisions).
- **Traffic throughput benefit:** Does this application optimize traffic throughput?
- **Environmental benefit:** Does this application reduce CO2 emissions?
- **Safety benefit:** Does this application enhance the general traffic safety for the community of road users?
- **Community benefit:** Does this application provide benefit for a community of travellers?

Figure 2.3 shows the lower part of the same webpage and the question from a SP-centric point of view. The feedback from the survey from these questions were not considered for the selection process for now. The outcome of these questions is discussed in the relevant section in Chapter three, four or five.



	not challenging										very challenging	no answer
	0	1	2	3	4	5	6	7	8	9	10	
Technology challenges: Please rate how challenging the development of this application is from your point of view.	○	○	○	○	○	○	○	○	○	○	○	○

If you see any major risks for this application please provide your expert's view:

Technical risks: May any technical risks threaten this application?

Financial risks: May any financial risks threaten this application?

Legal issues risks: May any legal rights threaten this application?

Organizational risks: What organizational challenges need to be overcome so that this application works?

Behavioral risks: Why may end users not use this application and how may end user misuse this application?

Is there anything that has not been addressed so far but that you think is important considering when developing this application?

For questions please contact anja.winzer@eict.de. She will direct your questions to the correct person.

To pause the session close the browser after clicking "Save and next". To restart the session use the same link you received by mail.

Back

Save and next

Harald Widlroither - Fraunhofer IAO

Figure 2.3: Screenshot application centred survey, part two

2.3.3 Survey execution and feedback

The survey took place between 13th and 20th of March. 31 replies were received. The number is very high concerning that it was sent only to internal stakeholders. The survey results were analysed by each sub project and results of the analyses are included in this deliverable in chapters 3.5, 4.2 and 5.2. The results of the survey are going to be used throughout the project.

2.4 Selection results

The final selection of applications, which will be further analysed, specified and implemented within the TEAM project is the following:

- Collaborative ACC
- Collaborative parking
- Driving and merging
- Serious gaming (for drivers and travellers)
- Collaborative eco-friendly navigation
- Collaborative pro-active inter-urban monitoring and ad-hoc control
- Collaborative co-modal route planning
- Co-modal coaching with support from avatar
- Collaborative smart intersection for intelligent priorities
- Collaborative public transport optimization
- Collaborative dynamic corridors

We assessed applications in three steps as outlined before in the context of the TEAM project and the above list is the final selection. As some aspects of applications, which were not selected, appeared valuable fror TEAM as well, the consortium decided to integrate these aspects in related selected applications as follows:

- Aspects of the application co-operative vehicle-highway automation system (platoon) went into the collaborative ACC application
- Relevant aspects of the application V2I Traffic Optimization went into Collaborative pro-active inter-urban monitoring and ad-hoc control

- Co-operative flexible lane allocation will be covered by the Collaborative dynamic corridors application
- The application collaborative eco-friendly navigation will cover relevant aspects of the application Traffic information and recommended itinerary

3 Details on stakeholders and survey results in the context of basic technologies and test sites

In this section the stakeholders and the survey results are discussed in the context of basic technologies.

3.1 Stakeholders

There are 27 beneficiaries altogether listed in the Description of Work; simultaneously all these are the internal stakeholders of the project as well. The TEAM pilot sites play a significant role in this project and there are also organizations that are strictly related to these pilot sites. City authorities can be considered as an example of this type of an organisation. However, these organizations are not project partners but part of the project ecosystem as external stakeholders. There are also several other type of organizations linked to the project, for instance hardware or software supplier of the project beneficiary. Also organizations from pilot sites and beneficiaries' OEMs are all defined as external stakeholders. So the division between internal and external stakeholders is clear and strict.

In developing process it is important to define the users so that the user perspective will be taken into account from the beginning. Sub-projects SP3 and SP4 are developing applications for end users. The aim is that the applications could be deployed in real use. The role of the sub-project SP2 is to design and develop basic technologies for SP3 and SP4. The users of basic technologies are thus the developers of relevant components, applications and enblers in the sub-projects, SP3 and SP4.

All the project beneficiaries listed in the Description of Work are listed in the table below (table 3.5.1). There are 27 different beneficiaries. Two of the beneficiaries consist of several organizations so there are 30 internal stakeholders in total in the project. The beneficiaries come from nine different countries throughout Europe and represent different actors in ITS sector. This gives an excellent basis for the project.

Table 3.1: List of internal beneficiaries (Description of work)

No.	Beneficiary	Beneficiary organisation full name	Country
1	FRAUN-HOFER	Fraunhofer-Gesellschaft zur Förderung der angewandten Forschung e.V.	DE
	FOKUS	Fraunhofer Institute for Open Communication Systems	
	IAO	Fraunhofer Institute for Industrial Engineering	
	IZB	Fraunhofer Institute Centre Schloss Birlinghoven	
2	5T	5T s.r.l.	IT
3	AIT	Österreichisches Forschungs- und Prüfzentrum Arsenal Ges.m.b.H.	AT
4	BMW F+T	BMW Forschung und Technik GmbH	DE
5	COSMOTE	Cosmote Mobile Telecommunications S.A.	GR
6	CREATE-NET	Center for REsearch And Telecommunication Experimentation for NETworked communities	IT
7	CRF	Centro Ricerche FIAT S.C.p.A.	IT
8	DELPHI	Delphi Deutschland GmbH	DE
9	UNIGE	Department of Naval, Electrical, Electronic and Telecommunications Engineering – University of Genoa	IT
10	EICT	European Center for Information and Communication Technologies GmbH	DE
11	E-TRIKALA	e-TRIKALA S.A.	GR
12	ICCS	Institute of Communication and Computer Systems	GR
13	IMC	Intel Mobile Communications GmbH	DE
14	INFOTRIP	Infotrip S.A.	GR
15	INTEL	Intel GmbH	DE
16	MIZAR	SWARCO MIZAR S.p.A.	IT
17	NAVTEQ	NAVTEQ B.V.	NL
18	NEC	NEC Europe Ltd.	UK
19	NUIM	National University of Ireland Maynooth	IR
20	NXP	NXP Semiconductors Netherlands B.V.	NL
21	RAMBOLL	Ramboll Finland Oy	FI
22	RELAB	RE:Lab s.r.l.	IT
23	STS	Swarco Traffic Systems GmbH	DE
24	TI	Telecom Italia S.p.A.	IT
25	TUB	Technische Universität Berlin	DE
	COGA	Combinatorial Optimization & Graph Algorithms Group	
	DCAITI	Daimler Centre for Automotive IT Innovations	
26	VTEC	Volvo Technology Corporation	SE
27	VTT	Teknologian tutkimuskeskus VTT	FI

3.2 Stakeholder questionnaire and classification

In task 2.2.2 the main objective is to ensure that all the relevant stakeholders of enabling technologies are identified and integrated. The task was started by sending a questionnaire to all TEAM pilot sites. Pilot sites (Table 3.2) were chosen because they represent the users (which correspond to the developers and integrators in SP3 and SP4). TEAM applications will be tested in these pilot sites and also the leading actors of the SP3 and SP4 are related to certain pilot site in the project. Also the activities of these organisations are focused on the pilot site. This is also the rationale behind the question for the project beneficiaries of naming also the external stakeholders.

Table 3.2: TEAM pilot sites

TEAM pilot sites		
Country	City	
Italy	Turin	Trento
Germany	Berlin	
Greece	Athens	Trikala
Finland	Tampere	
Sweden	Gothenburg	

One part of the stakeholder identification was the stakeholder classification. Internal and external stakeholders were classified for six different categories: Transport Company, Developer/Service Provider, Road Operator / TMC operator, Public Transport Operator, Local Authority and Other. Each pilot site representative received a blank table and the representatives were responsible of filling in the tables and classifying the stakeholders.

Responses were collected and the filled tables are listed below. Italian and Greek pilot sites are combined and the contact sections have been removed from this document. As the charts include both internal and external stakeholders, project members have been marked in the tables.

Table 3.3: Tampere stakeholder table

FINLAND	Tampere
Type of stakeholder	***Stakeholder Details***
Transport Company	Tampere City Transport

Developer / Service provider	Ramboll, **TEAM participant** VTT, **TEAM participant** **Gecko** Indagon Nokia PLCHelpten Aplicom
Road operator / TMC operator	Finnish Transport Agency, Road Traffic Management Centre
Public transport operators	Tampere City Transport
Local Authority	The City of Tampere Finnish Transport Agency Finnish Transport Safety Agency Centre for Economic Development, Transport and the Environment
Other	
Contact	

Table 3.4: Berlin stakeholder table

GERMANY	Berlin
Type of stakeholder	***Stakeholder Details***
Transport Company	-
Developer / Service provider	SWARCO TRAFFIC SYSTEMS GMBH, e.g. Berlin traffic lights
Road operator / TMC operator	VMZ (management of (road) traffic information in Berlin)
Public transport operators	BVG (Berlin public transport operator)
Local Authority	Senate Department for Urban Development and the Environment Berlin
Other	FOKUS-Fraunhofer Institute for Open Communication Systems, **TEAM participant**
Contact	

Table 3.5: Greece stakeholder table

GREECE	Athens, Trikala
Type of stakeholder	***Stakeholder Details***
Transport Company	Speedex, ELTA Courier
Developer / Service provider	ICCS, **TEAM participant** INFOTRIP, **TEAM participant** COSMOTE, **TEAM participant** taxibeat
Road operator / TMC operator	Road to the Future Alliance
	Attiki Odos
Public transport operators	KTEL of Trikala
	Athens Urban Transport Organisation
	Urban Rail Transport
Local Authority	e-Trikala, **TEAM participant**
	Ministry of Infrastructure, Transport and Networks
Other	Hellenic Association of Car Importers Representatives Hellenic Institute of Electric Vehicles, Greece ITS Hellas Centre for Renewable Energy Sources, Greece Hellenic Institute of Transport (HIT) - Center for Research and Technological Development (CERTH) NTUA Road Safety Observatory
Contact	

Table 3.6: Italy stakeholder table

ITALY	Turin, Trento
Type of stakeholder	***Stakeholder name and Details***
Transport Company	GTT Group

Developer / Service provider	Centro Ricerche FIAT (CRF), **TEAM participant** Mizar, **TEAM participant** Telecom Italia, **TEAM participant (Telecom service, LTE)** Nokia, **TEAM participant (LDM and component provider)** Tecnositaf, Magneti Marelli
Road operator / TMC operator	5T, **TEAM participant** Sitaf Autostrada del Brennero (Local motorway operator)
Public transport operators	GTT Group
Local Authority	Regione Piemonte Province of Turin Turin Municipality
Other	
Contact	

Table 3.7: Sweden stakeholder table

SWEDEN	Gothenburg
Type of stakeholder	***Stakeholder name and Details***
Transport Company	Volvo Logistics (VLC), local transport firms contracted by VLC, the Volvo test fleet operated by VLC
Developer / Service provider	Volvo Group, **TEAM participant**
Road operator / TMC operator	Trafikkontoret - City of Gothenburg
Public transport operators	Västtrafik, local bus operators contracted by västtrafik
Local Authority	Trafikverket, local bus operator
Other	Local transport companies and bus operators will be selected by planners 2-3 months before the start of the pilot.
Contact	

3.3 TEAM survey

The TEAM survey structure is described earlier in Chapter 2.2. The survey provided information for SP2, especially from two perspectives. Firstly it gives information what are the applications of interest to stakeholders. The applications with high interest require more attention from technology developers. For example, if the application is stated to have a very high end user acceptance, the technology developers need to make sure that the technology is user friendly. Secondly, the survey reveals the applications that might have a high technology risk and thus might be challenging for technology developers. In addition, the survey provides information of which stakeholders are interested in what applications.

3.3.1 Technology challenges

Technology challenges are ranked from 1 to 11 where 1 is "not challenging" and 11 is "very challenging" (Figure 3.5.1). The midpoint for ranking scale is 6. Technology challenge analysis shows that each application has technology challenges. When ranking technology challenges the mean value is over midpoint with each except one application. Nine applications get mean value over 8,0. The highest mean value is 9,0 and the six most highest mean values vary from 8,4 to 9,0.

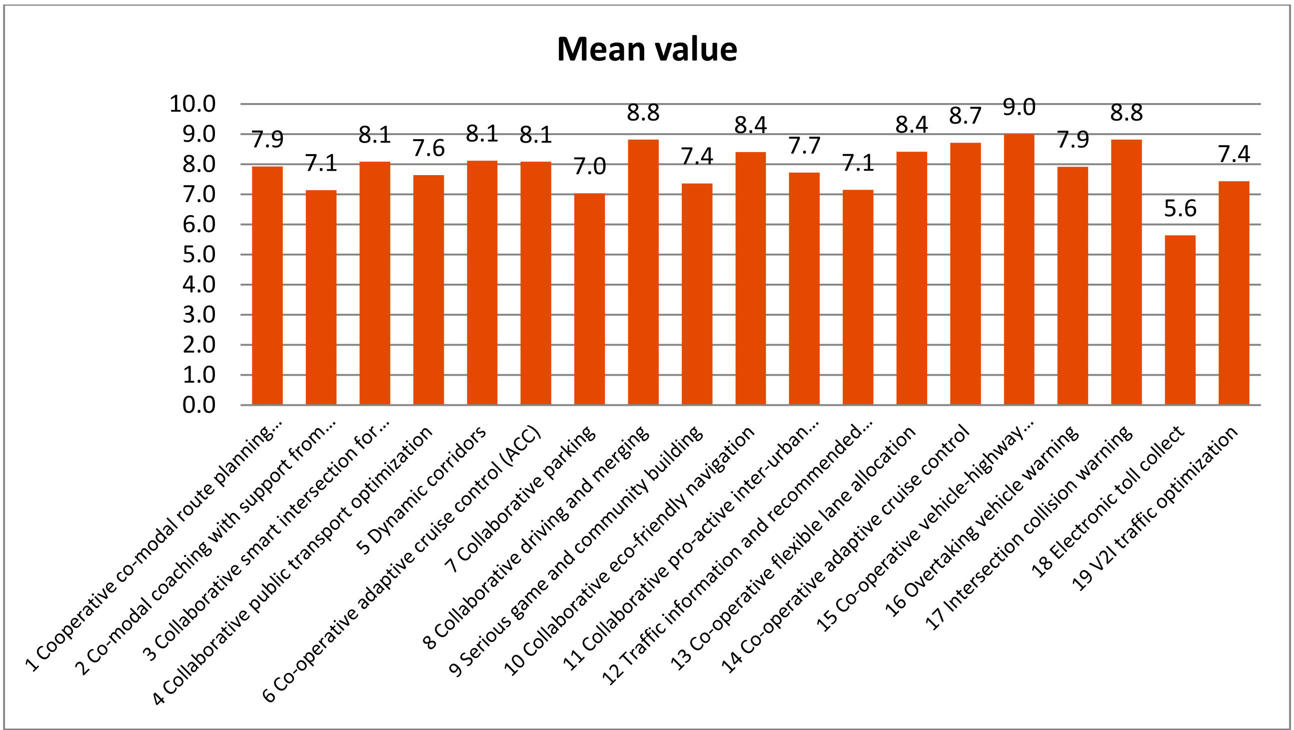


Figure 3.1: Mean values of the applications' technology challenges

Six most challenging applications based on the mean value are:

1. Co-operative vehicle-highway automation system (mean value 9,0)
2. Collaborative driving and merging (8,8)
3. Intersection collision warning (8,8)
4. Co-operative adaptive cruise control (8,7)
5. Collaborative eco-friendly navigation (8,4)
6. Co-operative flexible lane allocation (8,4)

Standard deviation (Figure 3.5.2) describes how the values vary around the average value. The larger the standard deviation is the more the values vary. Small standard deviation supports the mean value, from which it follows that smaller standard deviation is better.

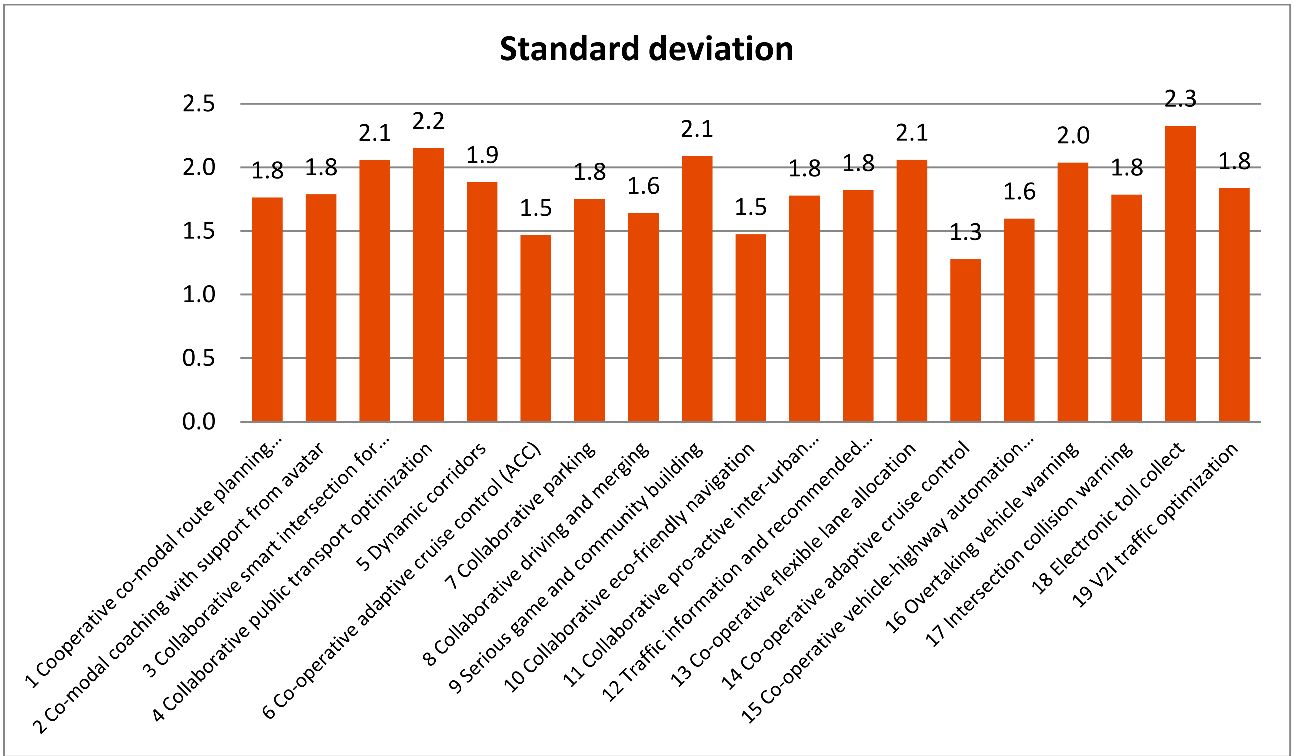


Figure 3.2: Standard deviation of the applications' technology challenges

In the survey there is also an option to choose "no answer" or skip the question. These are excluded from the mean value and standard deviation calculations. Nevertheless, these blank answers give information as well. It is possible that the no answer is given because the respondent does not know well the application or the respondent sees that technology challenges are not valid with this application. However, the high number of skipped and "no answers" do not indicate that the application would be challenging from the technology viewpoint.

Figure 3.3: Number of skipped and no answers in the technology challenges

The standard deviations and number of empty answers of the six applications with highest mean value:

1. Co-operative vehicle-highway automation system (standard deviation 1,6; empty answers 2)
2. Collaborative driving and merging (1,6; 9)
3. Intersection collision warning (1,8; 4)
4. Co-operative adaptive cruise control (1,3; 10)
5. Collaborative eco-friendly navigation (1,5; 1)
6. Co-operative flexible lane allocation (2,1; 2)

The standard deviation value over 2 is relatively high when the maximum value can be 5. The number of skipped and "no answers" are calculated and analysed because if the number is high it implicates that the technology does not play significant role in the application. Still the number is not as significant as mean value and standard deviation because the samples vary still between 21 and 30 and the meaning of the "no answers" is not clear.

The survey and the analysis show that the five most technology challenging applications are:

7. Co-operative vehicle-highway automation system
8. Collaborative driving and merging
9. Intersection collision warning
10. Co-operative adaptive cruise control
11. Collaborative eco-friendly navigation

Respondent had also a possibility to give open answers concerning the technical risks. All these five applications got several open answers. Actually multiple risks have been identified separately for all applications. Typically the risk was related to data accuracy. For example, stakeholders have identified that co-operative adaptive cruise control has risk concerning "accuracy of sensed data; real-time data fusion; accurate traffic information". The fact that the data need to be real time generates risks and that needs to be taken into account when developing the technologies.

Also privacy issues are named as risks for many applications. For instance, the application may need speed and location data and if there is a possibility that an application may need to save the data, it causes problems with privacy. Users are very concerned that the data may be used somehow that it will be harmful to users.

Many applications are found to be very complex and stakeholders are afraid that it could prevent application to be functional. Also many applications are used in situations where they must work properly. Applications' operating errors may result accidents which may cause severe accidents. This has to be taken into account in the designing process. For example, it is stated that co-operative vehicle-highway automation system "requires a 120% robust system."

The survey illustrates that most of the applications include technological challenges and risks. This complies with the impression that ITS-applications are very technology-oriented and the well designed and produced technology is always key to success.

4 Stakeholder preferences and constraints for FLEX applications

In this chapter, stakeholders and survey results are discussed from a SP3 point of view. Although different persons and companies will be involved dependent on the region of application, categories of stakeholders can be identified being region independent. The following categorization has been made:

- Users: The actual users of an application or service.
- Infrastructure Suppliers: Bodies providing infrastructure. Among others this includes owners of streets or rail tracks.
- Road Infrastructure Operators: Road operators are companies focusing on the operation of roads (e.g. highways).
- Public Transport Operators: Analogously to road operators, public transport operators are those companies providing public transport services on public transport infrastructure.
- Local Authorities: Local authorities includes bodies like "The City of …".
- Traffic Management Centres: Traffic management centres are often operating on behalf of local authorities. They are focusing solely on the management of traffic in a city or region.
- Pilot Site: Pilot sites are project related and represent those (local) stakeholder involved in the presentation of the TEAM-results at the chosen cities/regions.
- Automotive OEM: Automotive OEMs define what is attractive to the Automotive Industry.
- Automotive Supplier: Automotive supplier have detailed technological knowledge an can assess particular aspects than no other party.
- Mobile Phone and Service Provider: Since all application involve network technology, service providers are part of the value chain. The mobile phone plays a central role for aftersales deplyoement of ITS technology.
- Research Institute or University: Have particular and neutral knowledge in selected fields.
- Others: All stakeholders not included in one of the above presented categories are collected in this category. This includes "SME in ICT field (pilot site)", "ITS solution provider", "Urban/Interurban road infrastructure provider", "Semiconductor component supplier", "IT company", "Semiconductor manufacturer", "Semiconductor component supplier".

In the following, for each of the above presented stakeholder categories extracted preferences and constraints will be presented in detail.

4.1 Users

Although the term "users" is quite generic, a more detailed description does not seem to be helpful since too specific user groups lead to many contradicting preferences and constraints without essentially providing added value. Therefore, we define the "users" as those individuals who are going to either use an application/service or who are participating in the traffic scene.

The main goal of the users is in fact quite egoistic: The main user wants to get from A to B on the fastest (or shortest) route while her convenience is maximised. In more detail this includes the following main targets:

- **Congestion avoidance**: Congested areas or traffic jams shall be avoided as much as possible. This can either be achieved based on the information available when pre-planning a trip or during travelling. In the former case, the user could decide to leave earlier (or later) to avoid peak hours. Furthermore, the mode of transportation could be adapted based on the information (e.g. do not use the car but take the bike instead). If the trip already started, real time information should be available such that routes can be adapted to avoid traffic jams or even change the mode of transportation: e.g. the bus line is left and a bike sharing system is used for the last mile, which could be much faster if the bus is standing in a traffic jam.
- **Smooth riding**: Furthermore, the users want to achieve a maximised driving experience. In fact, this means that either driving a car or e.g. travelling with a bus should be as convenient as possible. This includes free flow of the traffic along the chosen route. For this purpose, the driver (of a car or bus driver) needs to be informed on the current schedule of the next traffic light(s) for being able to adapt the speed of the vehicle such that no (total) stop is necessary. On the one hand, this obviously requires knowing the switching cycle of the traffic light, but also needs knowledge on the current traffic situation such that the lengths of queues in front of the traffic light can be estimated and can be incorporated into the speed recommendation given to the driver. By the way, even if the user is not a driver herself but only a passenger in e.g. a bus, smooth rides are much more preferable since especially in buses many people are standing and sudden breaks and/or accelerations are uncomfortable.
  Beside the ride quality, smooth riding also has a significant impact on the economic and ecologic level since decreasing the number of necessary stops also reduces the abrasion of the tires and breaks; decreasing the number of accelerations directly reduces the CO2 and

black carbon emissions by the vehicle since the rate of consumption is decreased which has, in fact, a positive effect on the money spent on gas. Therefore, the driver is not only interested in the signal pattern of the traffic light but in fact in the optimal speed for "having a green wave" along the route. Obviously, one needs to be aware that for example driving slowly for the next section because the light for left turn switches to green in e.g. 90 seconds, has also an effect on the drivers behind which might want to take the green light for right turns which is available in 45 seconds. So, although the individual driver might be interested in her current optimal speed, the driver might also be interested in the system optimal speed (having in mind that next time she drives behind another driver).
Finally, the driver wants to influence the traffic light pattern from an ego-centric view. I.e., the driver wants to travel with optimal speed (either with respect to time or e.g. with respect to consumption) without having to stop at traffic lights. Therefore, the driver wants to inform the traffic lights ahead the she is approaching them and they should turn to green along the route. If the driver is even a bus driver, than not only the driver herself wants to have the possibility to influence the traffic light but the passengers are benefitting of this possibility as well.

- **Improved bus services**: While influencing traffic lights for gaining green waves is mainly of interest for users within one vehicle, the "crowd" of passengers is interested in smoothed bus services, which means that the frequency of buses should be evenly distributed while the delays of the buses are kept low. Furthermore, the passenger wants to be informed on the current schedule as well as possible incidents. Many passengers would even accept that bus lines are re-scheduled at request, which means that for example certain stations are only approaches if there are passengers who want to enter (or leave) the bus at this station (e.g. dynamically adaptive express lines).
  In addition, the distribution of passengers to buses should be smoothed meaning that in cases where several buses are travelling right after each other, some passengers are asked to wait for the second bus (which will be there in one minute) such that the first bus is not overfilled and a possible delay of the first bus can even be decreased.

- **Peek service**: While most rides (especially in cities) are commuter rides, travelling to events (such as soccer games, concerts, etc.) of great importance as well. Especially in the case of sports events the number of people trying to get to the stadium as well as the number of people trying to get home again after the game is enormous—basically because they want to get there all at the same time. For this purpose, the traveller wants reinforced (bus) lines such that capacity is not the limiting factor. Furthermore, the users even want special services which is only relevant for certain situations (e.g. there are cities where extra bus lines are operated only on All Saint's Day towards the cemeteries).

- **Pre-trip information**: Many users want to plan their trips before they leave their origin, e.g. at home. For this purpose, the corresponding information needs to be available in best possible accuracy such that decisions on the mode of transportation to be used as well as the route decisions can be well made.
- **Online information**: During travelling the user should be informed about incidents along her route—especially if the incidents influence the chosen route and/or modality such that changing the current strategy might be advisable. Furthermore, it might be interesting for the user to compare her current choice with a virtual user who tries to travel the same way (origin to destination) but based on the (currently) best decisions.
- **Post-trip information**: Finally, the user wants to be informed on the quality of the chosen route after the route is finished. In fact, the user wants to know whether the chosen route and modality was really the best choice. Since this is a post-mortem evaluation, all data of all other possible routes should be available. Information gathered through this process can be used for future route planning. In addition, statistics on the users' performance are informative to the user helping her to decide which decisions should be made in the future.
- **Personalisation**: Although many systems supporting individual mobility are already on the market, most of these system do not recognise users when the "come back". However, this is a functionality requested by many users such that personal preferences can be stored which can then be incorporated for future uses.
- **Decision support**: The user wants decision support by the system which means that in situations where decisions need to be made, advices are gladly accepted. For example, the user could request information on the next route (e.g. when to depart, which mode of transportation should be chosen, etc.). Furthermore, synchronisation between different road users could be achieved (system optimal routing vs. user optimal routing) and user could be assisted in interactions (e.g. lane merging when entering a highway).
- **Information support**: In most situations, the user could behave much more system convenient when she would have the correct information. E.g. when knowing that two lanes will be merged in several hundred meters the driving performance of the drivers could be improved. Furthermore, traffic congestions could be bypassed when knowing that there is a traffic jam after the next traffic light. Pre-trip, online and post-trip information should be available to the user on request such that the traffic behaviour could be improved.

In summary, it should be highlighted that the users want to be informed such that the personal mobility behaviour is improved (e.g. choosing the correct mode of transportation). At the same time the users aim at the fastest, smoothest, etc. travelling experience possible. To achieve this, they want to have as much information on the current traffic state, incidents, etc. as possible. However, at the same time, the users do not want to be monitored by the "system".

4.2 Road Operators

Road operators, especially highway operators are mainly interested in two goals:

- **Safety**: On European roads every day thousands of almost accidents happen. Unfortunately, too much actual accidents are happening as well. The road operators are, however, interested in safe operations on their roads. Although human safety is important to them, this is also an economic factor. Accidents (and incidents) lead to destructions at the infrastructure which has to be repaired which obviously costs a lot of money. Therefore, drivers and travellers should be supported during their trips such that they are as safe as possible and no or only a minimum number of incidents occur.
- **Sustainability**: From an economic point of view, street wear should be as low as possible which includes roadway covering, traffic lights, road markings, rails, etc. If the traffic is optimised (e.g. though achieving a better modal split or by reducing accelerations and break situations) wear appearance could be reduced to a minimum.

So, all developments should focus (from the road operator's point of view) on safety and sustainability of the road infrastructure. The economic share is part of their basic orientation.

4.3 Public Transport Operators

Public transport operators are in a somehow conflicting situation: On the one hand, they want to maximise their profit, while on the other hand they want to provide best possible service to their customers. While some of the preferences and constraints stated by this group of stakeholders are contribute to achieve both major goals, some others are preferences for one while they are constraints for the other goal. Although public transport operators provide services like buses, trains, trams, etc., we focus on buses only since buses are often travelling on "normal" roads, i.e. no extra lanes are available, they have to wait at intersection, etc.:

- **Priority scheduling**: There is one thing which is even worse than standing in a traffic jam: standing in a traffic jam when sitting in the bus. Therefore, public transport operators want that their buses (or the drivers) can influence the traffic light patterns such that buses are always prioritised. Beside the fact that travel times are reduced, schedules are smoothed and delays are minimised, the ability to influence priority at (major) intersections leads to more economic (and

ecologic) driving as well since stops at traffic lights are minimised and therefore energy loss by breaking is reduced.
In addition, the priority of buses during peak hours is of enormous importance since buses should not be delayed by traffic jams. For this purpose, dynamic lane regulations could be helpful. E.g., during peak hours certain lanes are reserved for public transport vehicles only (e.g. buses and taxis), while during other times (off-peak) all vehicles may use these lanes.

- **Green wave buddy**: If influencing traffic lights is not possible, at least information on the signal pattern is preferred by the public transport operators such that an economic and ecologic driving style can be enforced by the bus drivers. If the information does not only cover the next traffic light but incorporates the next e.g. ten traffic lights optimal speed for gaining a green wave can be extracted.
Besides that, public transport operators want to achieve a constant flow of their vehicles (buses) over time such that the service to the customers is all the time as high as possible.

- **Dynamic bus lines**: Although major lines are frequently used, bus operators must also provide services in areas where the number of passengers is relatively low. For such regions, they would prefer to be more flexible: E.g. instead of having fixed lines, the routes of the buses should be adapted according to the customers' needs (e.g. if there is currently no ride from/to a specific street than this region could be bypassed).
On the contrary, additional services can then be provided if the demand rises above the typical level, e.g. due to sports events.

- **Synchronisation**: Another major goal for public transport operators is to gain maximum synchronisation between buses of one line and buses of intersecting lines. While along one line it is sufficient to ensure that the frequency of the buses is as desired, buses of intersecting lines have to be synchronised with each other such that connection security is given at all times.

- **Service maximisation**: Finally, public transport operators want to maximise their service to the customers. For this purpose, the number of lines as well as the frequency along the lines should be maximised while the costs should be kept as low as possible.

In summary, the service and the quality of the service should be maximised while costs should be minimised. As always, those two goals are partially contradicting each other and it is therefore necessary to find a good balance between them.

4.4 Local Authorities

This stakeholder group include city governments (also national government etc.) as well as "the community" (which is finally represented by the governments):

- **Modal split**: Since the overall traffic cannot be (essentially) reduced, local authorities aim at changing the modal split (distribution of travels among all modes of transportation) such that a shift towards public transport (including cycling, walking, bike sharing) can be achieved. Modes of transportation emitting much CO_2 and black carbon should be minimised such that the quality of life is improved in the city/region.
- **Congestion reduction**: Since congestions are not only annoying for car drivers but also for cyclists, pedestrians, public transport, and residents, the clear aim is to reduce congestions while maximising the traffic flow without increasing the flow quantity. I.e. traffic jams and congestions are avoided.
- **Respect**: Furthermore, local authorities are interested in road users respecting each other as well as residents and special facilities along the (main) roads. For example, it is desired that in front of schools and hospitals the speed is reduced. While hospitals are continuously operated, schools are only operated for several hours per day. Therefore, dynamic traffic signs and e.g. dynamic one ways or special school bus lanes are desired.
- **Good behaviour**: Analogously to respecting each other and taking care of the weak ones, it is also desired that road users behave well. So, for example, road users should be persuaded to change their mode of transportation towards public transport, cycling and walking.
- **Access control**: Many cities have special regions with regulated access control, meaning that only special types of vehicles (e.g. only public transport, or only e-mobiles) are allowed to enter the area. Access control should be done fully automatically by the car and access control system such that the drivers do not need to do anything else than driving.
  However, enforcement of access regulations should be done by the system as well. E.g. if someone without access rights drive within the regulated area tickets should be automatically issued.

In brief, local authorities are interested in representing the residents' preferences. In addition, they want to reduce congestion, a positive shift of modal split and access control to regulated areas. Obviously, local authorities want traffic management done according to their rules.

4.5 Traffic Management Centres

Traffic management centres are a core component in the traffic system, since they are somehow the interchange node between the local authorities, the users and the road and public transport operators. So their main goal is to management the traffic such that all (other) stakeholders are satisfied. However, traffic management centres have their own preferences and constraints which are only necessary to fulfil the preferences and constraints stated by the other stakeholders. Therefore, those traffic management centre preferences are important but not "self-contained":

- **Current traffic state & forecast, historic data**: To perform the operations expected by a traffic management centres, it is necessary to get information on the current traffic state and to forecast the traffic state in the near future (e.g. within the next one to two hours). In addition, it is necessary to run statistics such that even long term forecasts can be done. For this purpose, all sensor data available needs to be collected by the traffic management centres: e.g. count data from loop, current speed/travel times from cars, traffic light signal patterns, etc.).
- **Reaction to incidents**: While main traffic management strategies might be applied on "typical" days, special strategies have to be developed if incidents occur. On the one hand those incidents need to be detected while on the other hand (optimal) reactions to them need to be derived. In addition, the behaviour of the people involved in the incidents as well as the people informed about the incident needs to be predicted. E.g., rules like "10% of all drivers will try to bypass this congestion via Interstate X" need to be derived.
- **Flow maximisation**: In fact, traffic management centres want to maximise the throughput of the (street) network such that congestions are minimised. For this purpose, it is necessary to manage the traffic by (dynamically) changing traffic light signal patterns, adapt (bus) lanes or open/close regulated areas for "public" use.
- **Provide data to third party companies**: In addition to fulfil their tasks by management the traffic, traffic management centres are also interested in selling the data gathered to third party companies which might then provide additional services to customers (e.g. parcel distributors might want to inform their customers on estimated arrival times of the parcels).

4.6 Automotive OEM and suppliers

For automotive OEMs and suppliers, the possibility to provide traffic information to the driver is a competitive advantage. Therefore, vehicles and components need to have all equipment for gathering (traffic) information, provide this information to the traffic management centre and to receive traffic information gather by others. Based on this "basic" functionality, the drivers can be informed and engine management strategies etc. can be adapted (e.g. using electric drive in regulated areas only for plugin hybrid vehicles).

4.7 Others

Beside the above mentioned stakeholders, a significant part of the traffic is caused by logistics providers. Obviously, they are interested in providing good services to their customers. For this purpose, they might be interested in buying traffic information data from traffic management centres. However, in most cases, they will not be interested in raw data but in data which is already post processed and can be directly used for their internal tasks.

Last, but not least, one important road users are operational emergency vehicles. Their main goal is very easily expressed: They want to be as fast as possible while disregarding all constraints and preferences of all other stakeholders. Therefore, they are, for example, interested in dynamic lane selection, i.e., in systems providing empty lanes for emergency rides when needed. If no emergency is given, then those lanes can be used by all other road users as well.

5 Stakeholders of mobile applications and enablers

This chapter describes the stakeholders in the context of the subproject 4. It includes a discussion of the survey results.

5.1 Stakeholders overview

In the scope of TEAM, all the project partners are considered as internal stakeholders. They do not represent the whole range of stakeholders of interest for the project, but they constitute an optimal starting point for preliminary investigation about TEAM applications.

Stakeholders involved by DIALOGUE sub-project are primarily those stakeholders that have an interest in mobile technologies, being DIALOGUE the sub-project that fosters dialogue among road end users. Therefore, those stakeholders that are primarily addressed in DIALOGUE are Mobile phone and service providers, apart from end users (i.e. drivers and travellers).

Nevertheless, being DIALOGUE applications to some extent the terminal part of the whole TEAM project concept, and having DIALOGUE strong liaisons with FLEX and EMPOWER (as mentioned in the previous paragraph), all stakeholder categories envisaged in TEAM are at some extent involved.

As a first step of investigation of stakeholder needs - not yet involving external stakeholders and end users, but aiming to better address the further investigation that will involve them – a survey among the internal stakeholders have been done and it is described in the following paragraph.

For a more detailed description of internal stakeholders see paragraphs 3.5.1 and 3.5.2.

5.2 Stakeholders survey description

The stakeholder categories included in the first, preliminary SH survey are the following:

- Automotive OEM
- Automotive Suppliers
- Road Operator
- Mobile Phone and service providers
- Local Authorities
- Public Transport Operators
- Research Institutes and University
- Pilot Sites

As a proof of what stated in paragraph 5.2.1, all kind of stakeholders provided valuable feedback on DIALOGUE applications.

The survey consisted of a set of closed questions, administered by means of an online tool, where participants were asked to rate on a 10-point scale each TEAM application (i.e. all applications from EMPOWER, FLEX and DIALOGUE) under the following viewpoints:

- Business case
- End user acceptance
- Mobility of travellers
- Traffic throughput benefit
- Environmental benefit
- Safety benefit
- Community benefit
- Technology challenges

Furthermore, technology challenges for each application were addressed, and participants have been asked to name potential risks raised by the applications (technical, financial, legal, organizational and behaviour-related).

Participants had the chance to skip those questions or applications that they felt they were not able to answer on, due to different expertise.

Finally, they had the chance to add any kind of further observation or remark that had not been addressed by the survey.

The reason why only TEAM internal stakeholders have been approached stays in the fact that the project is still in its early phases. Externals will be included in the follow up SHF when the complete set of survey results can be reported.

However, it is already possible to draw some overall indications, reported in the next paragraph.

5.3 Results

Average results show that all DIALOGUE applications received positive ratings among stakeholders under each evaluation category, being all average scores between 6.8 out of 11 (mean value for safety benefit) and 8.1 out of 11 (mean value for End user acceptance), where 1 means "not at all", 11 means "very much" and 6 is the medium point.

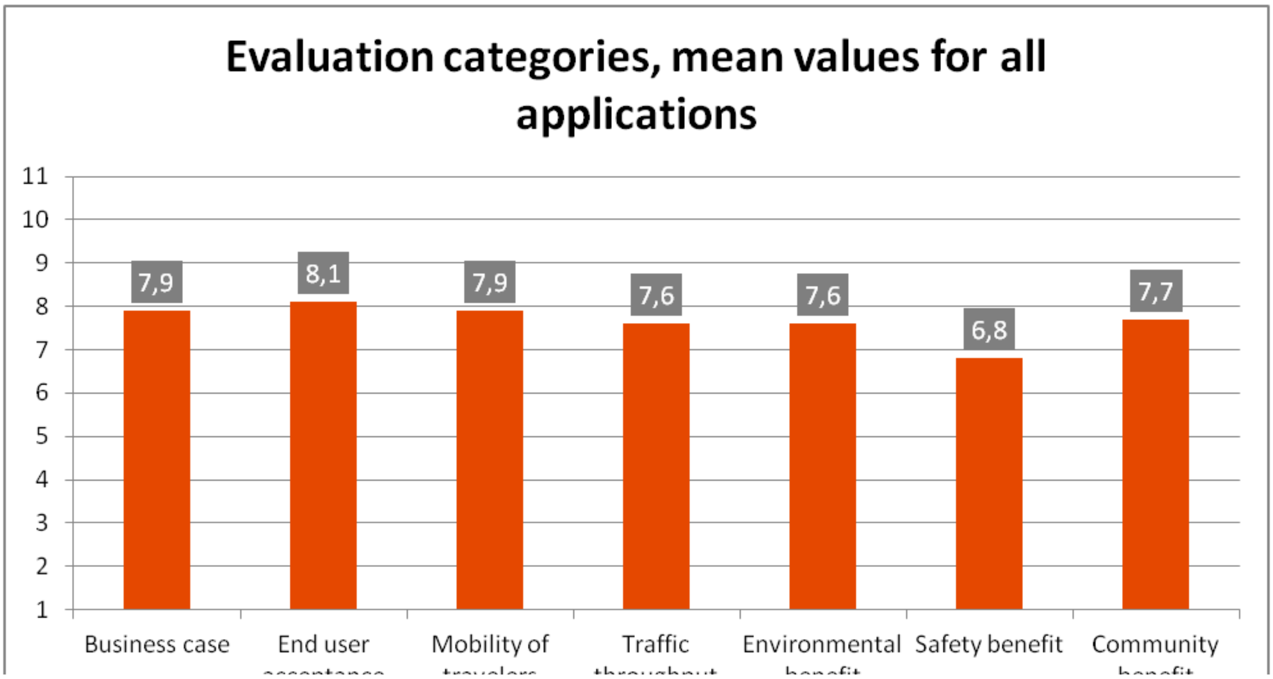


Figure 5.1: Evaluation categories - overview

Technology challenge has also been investigated by the survey, and the results show that all DIALOGUE applications are seen as quite challenging by stakeholders (where 1 meant "not challenging at all" and 11 meant "very challenging", being 6 the medium point), being "Collaborative driving and merging" the most challenging (8,82), and "Collaborative parking" the least (7,03).

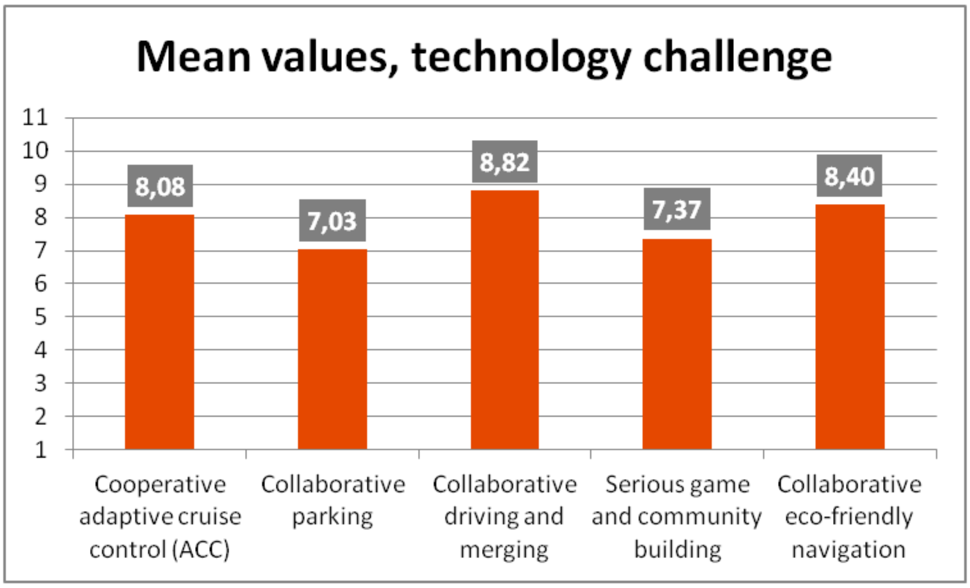
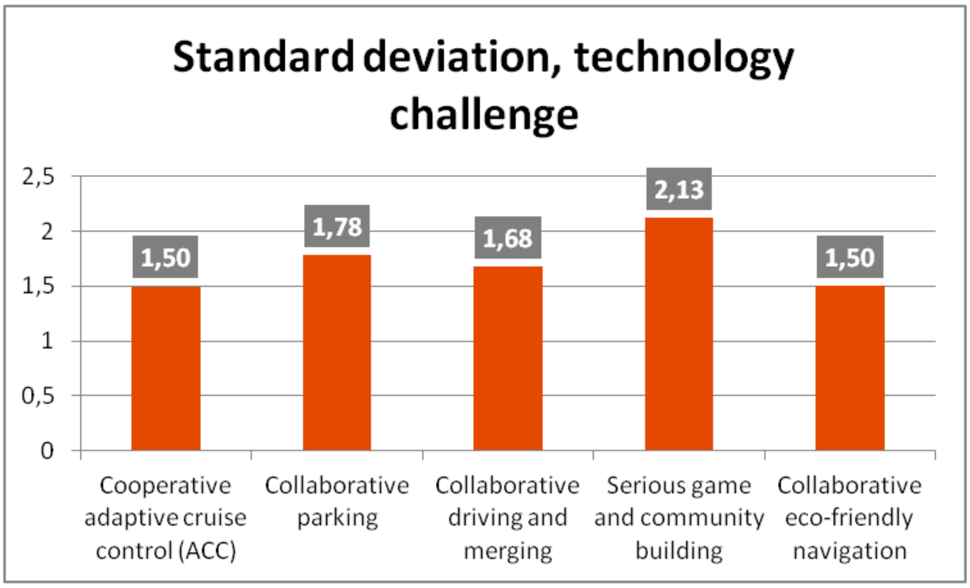


Figure 5.2: Mean values, technology challenge

Standard deviation values show how technology challenge scores obtained by DIALOGUE applications vary around the mean value, being the highest deviation 2.13, obtained by serious game and community building.



Closely related to these results are the open comments provided by participants about the technical risks of these applications.

Data management and processing raise concerns, especially for the heterogeneity of the collected data that may lead to comparability issues.

Accuracy is often recalled as a key factor, seen as possibly tackling for most applications (e.g. accuracy of parking detection for collaborative parking, of vehicle detection for driving and merging, etc.).

5.3.1 Business case

When asked to rate the applications on how they could represent a business case, scores range between 8.74 and 7.63 out of 11, being 6 the medium point. Therefore all applications are well above the medium point. Still, they raise concerns on some financial issues, being the most named:

Figure 5.3: Standard deviation, technology challenge

- The actual interest for end users and therefore their willingness to pay for such applications
- The ownership of the application and therefore the ownership of related costs
- The attractiveness of the revenues generated

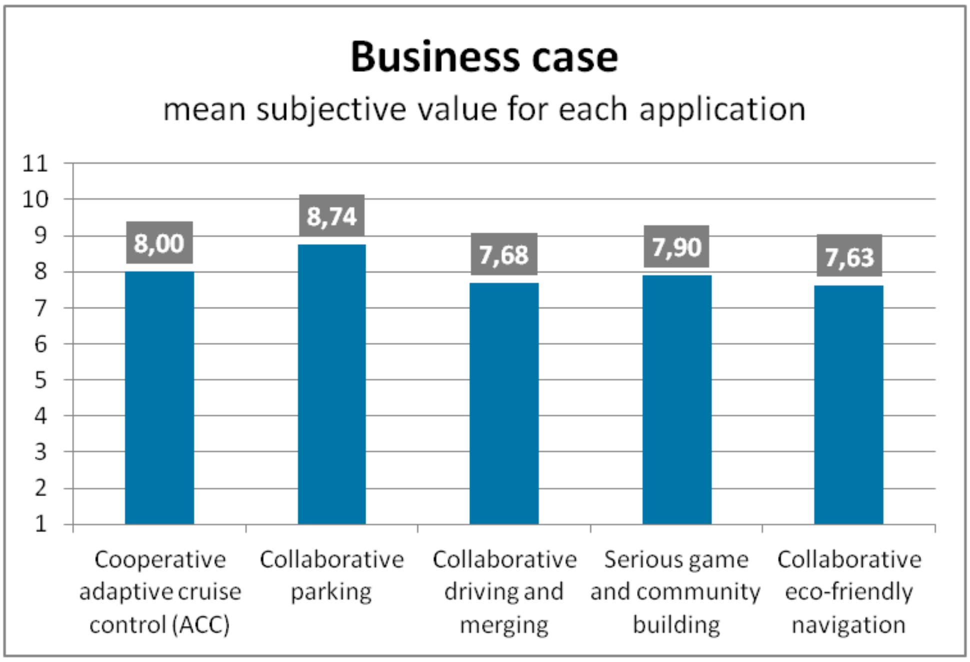


Figure 5.4: Business case - mean subjective value for each application

5.3.2 End user acceptance

End user acceptance of DIALOGUE applications, according to internal stakeholders, varies from 7.68 (Collaborative eco-friendly navigation) to 9.23 (Collaborative parking).

From subjective answers, it becomes clear that end user acceptance is strongly connected with systems reliability, a clear interpretation of the systems' instructions (and therefore the discouragement of misbehaviours), and a generalized users' uptake that is of primary importance for the adoption of such technologies.

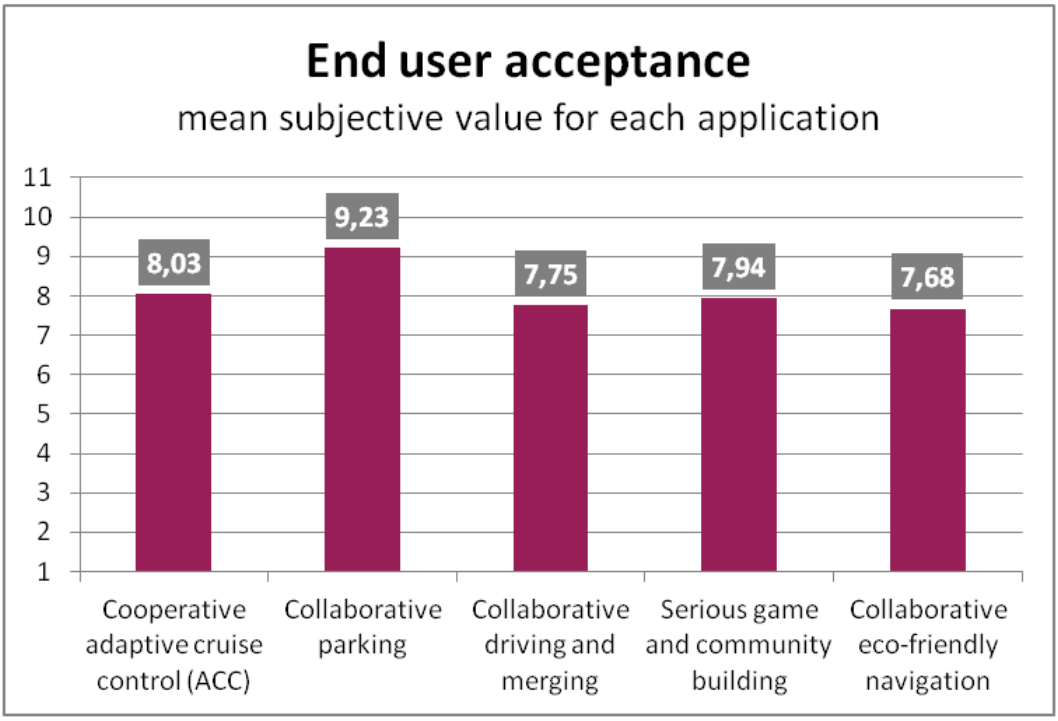


Figure 5.5: End user acceptance - mean value for each application

5.3.3 Mobility of travellers

Mobility of travellers benefits, according to stakeholders, is enhanced by Collaborative parking and eco-friendly navigation the most (8.87 and 8.65 respectively), while serious game and community building reaches the lower score with 6.97, being anyway higher than the midpoint.

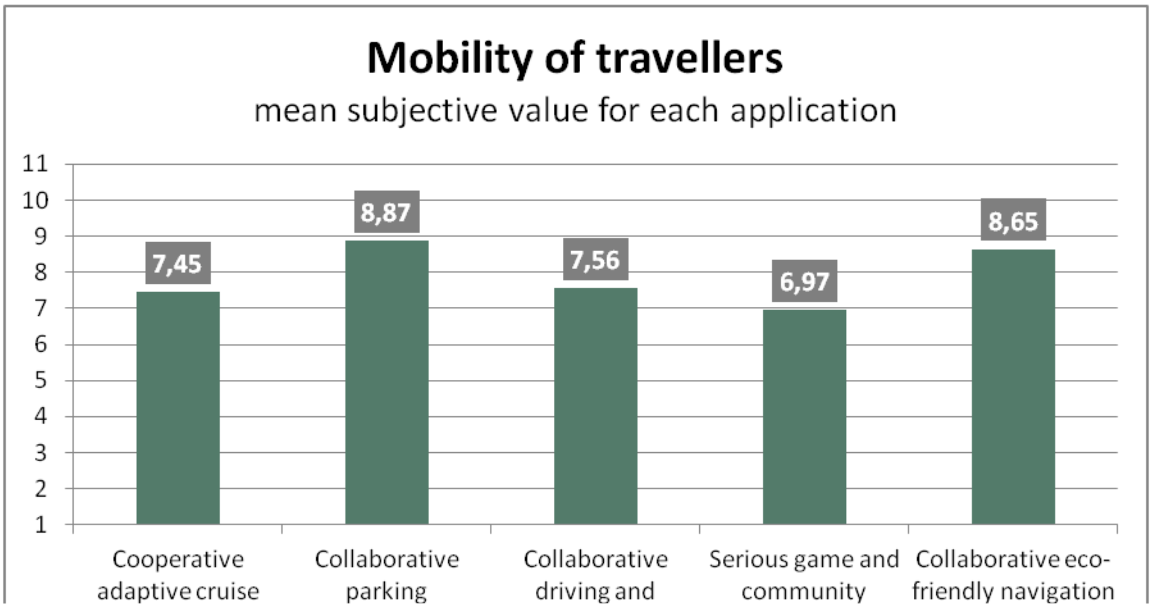


Figure 5.6: Mobility of travellers - mean subjective value for each application

5.3.4 Traffic throughput benefit

Traffic throughput gains benefit from all applications, being Collaborative adaptive cruise control (7.83), eco-friendly navigation (7.81) and Collaborative driving and merging (7.62) the ones with higher scores, even though there is not a large distance between them and Collaborative parking (7.00) and Serious game and community building (6.70).

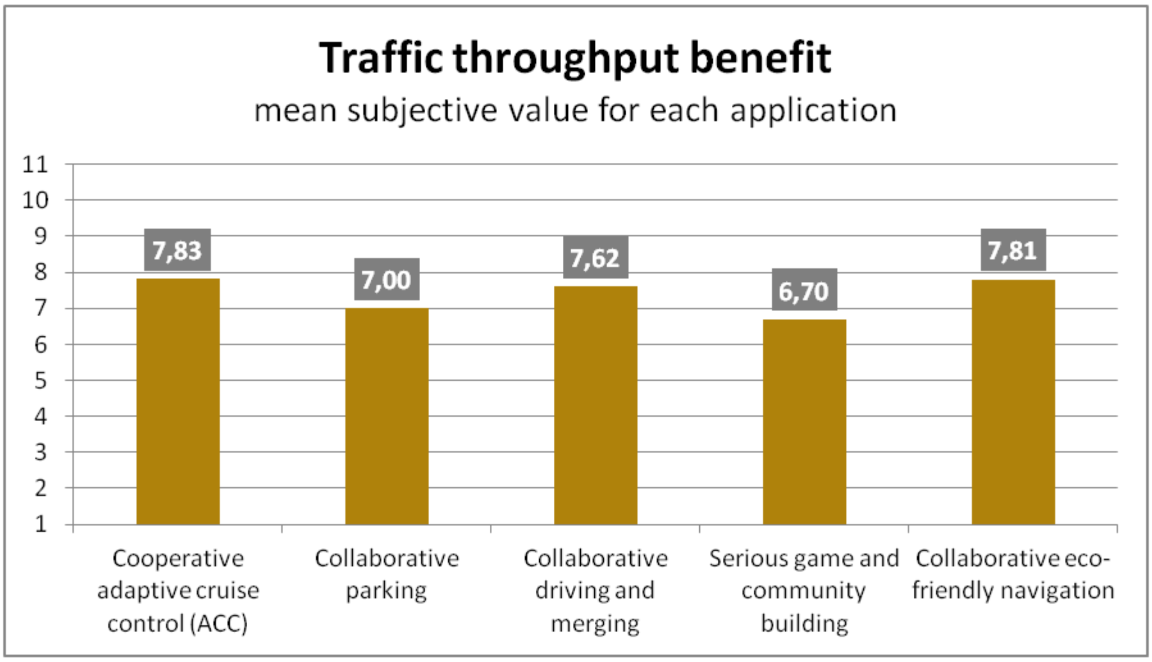


Figure 5.7: Traffic throughput benefit - mean subjective value for each application

5.3.5 Environmental benefit

Mean scores are also quite similar for environmental benefit as well, being all applications between 7.90 (Collaborative eco-friendly navigation) and 6.88 (Collaborative driving and merging).

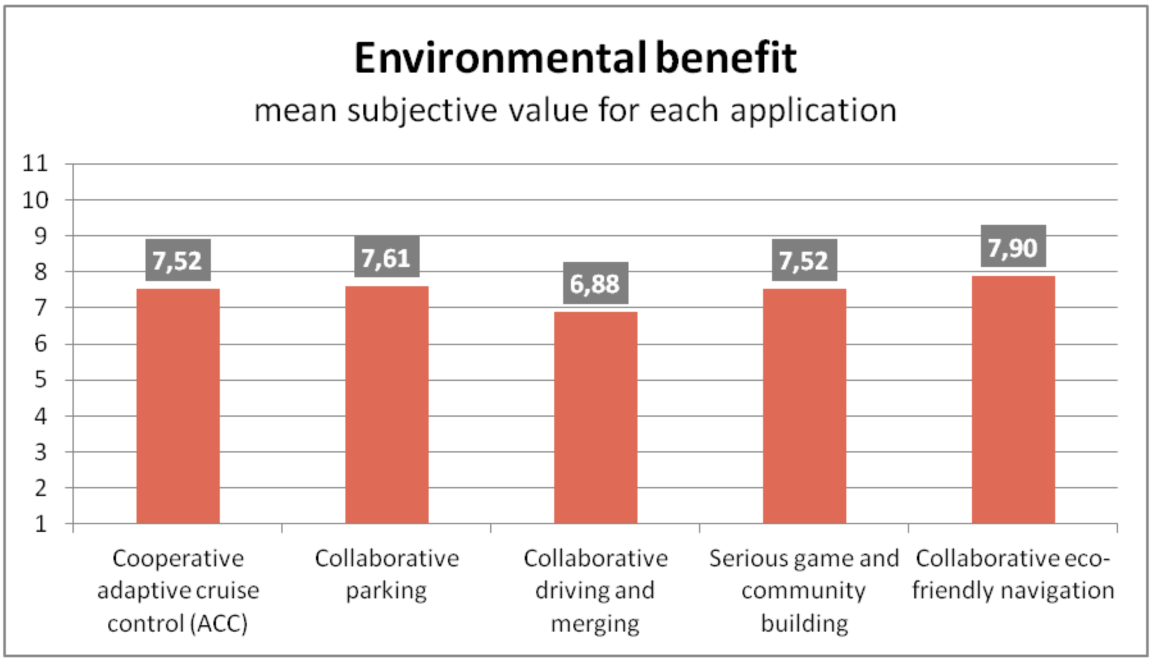


Figure 5.8: Environmental benefit - mean subjective value for each application

5.3.6 Safety benefit

Safety benefit is the aspect that generates the most significant distance among mean application scores. Collaborative parking and eco-friendly navigation score below the midpoint (5.10 and 5.48 respectively), raising some concerns about being potentially distractive for the driver.

While collaborative driving and merging is seen as the application that could enhance safety the most (8.36).

Some of the concerns raised by stakeholders regard the over-confidence that users may put in the system, leading thus to safety issues.

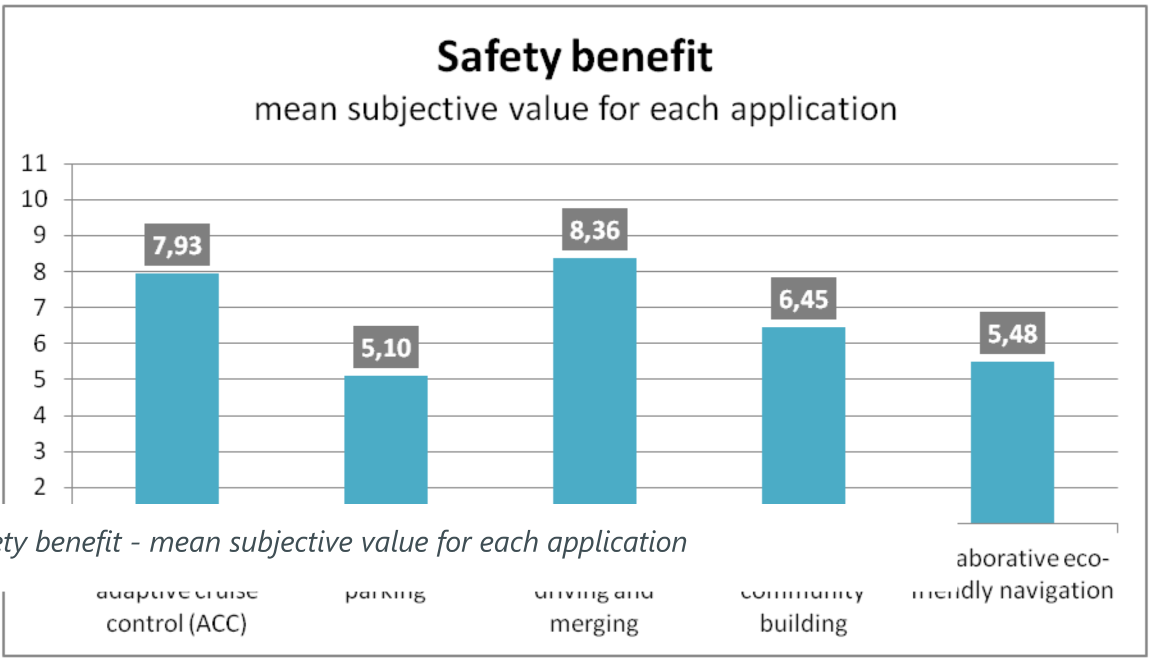


Figure 5.9: Safety benefit - mean subjective value for each application

5.3.7 Community benefit

Community benefit scores are the most similar among the applications, being all between 7.35 and 7.97. Therefore all above the midpoint but still not too high.

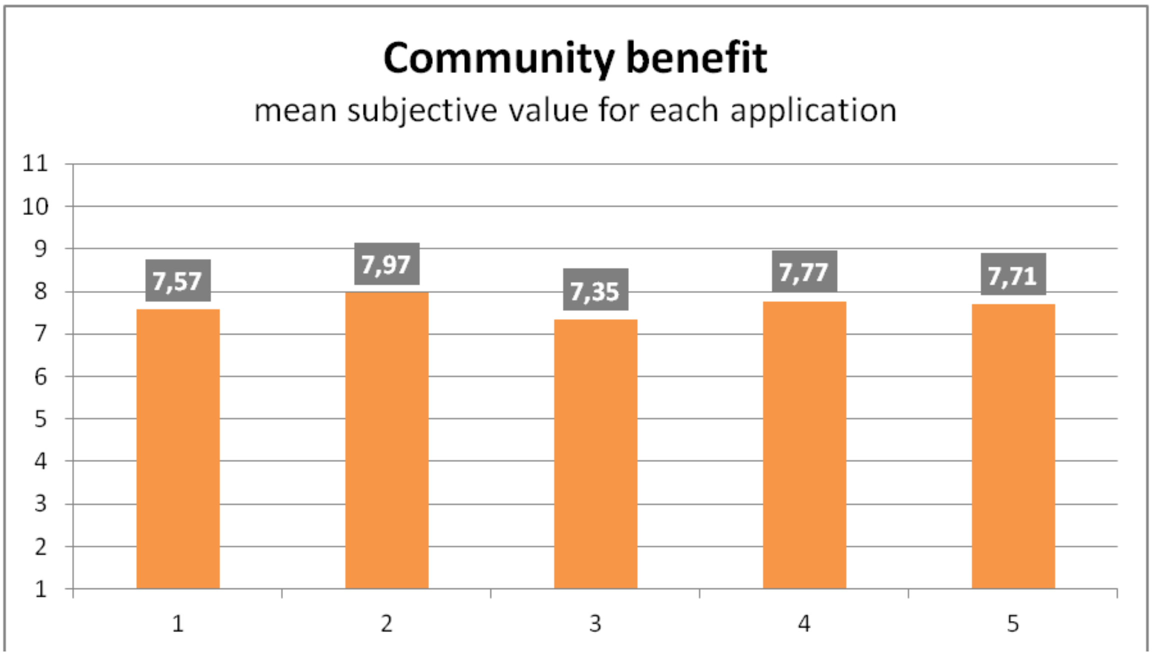


Figure 5.10: Community benefit - mean subjective value for each application

5.3.8 Summary

Apart from single cases, all applications have been evaluated above the average according to each evaluation aspect proposed by the survey.

Nevertheless, the open answers have given the chance to stakeholder to raise some concerns that must be taken into account, especially from the technical, financial and end user acceptance point of view.

Other relevant issues pointed out regards legal aspects (especially responsibility, liability, data security and privacy) and organizational aspects, especially the need of a considerable amount of equipped vehicles as a requirement for the applications to work properly.

6 Conclusion

This document summarizes the results of the work packages WP22, WP32 and WP42. Technical details are introduced in the Parts B,C and D. Together with this document, they for the deliverable D1.0.

All these work packages ran in parallel and started with the kick-off of the TEAM project. The work packages set the basis to the future work within TEAM - in particular within the three sub-projects EMPOWER (SP2), FLEX (SP3) and DIALOGUE (SP4). The main objective of this part of the project has been to define the applications (WP32 and WP42) and basic technologies (WP22) and their use cases, which will be analysed in greater detail within the TEAM project.

This deliverable is a joint deliverable of the three sub-projects. The joint nature helped to integrate the different actions in the three sub-projects. Even though the deliverable shows that not all statements and expectations are perfectly aligned over all the partners, the cooperative work of the many involved and contributing partners helped to develop an agreed view on the project. This outcome of the work is probably as important as the document itself with all the application and use case descriptions.

One of the main challenges of the work done has been the selection and agreement of topics (here applications, use cases, enablers, basic technologies), which will be addressed and further analysed in detail within the project. This selection has a deep impact on the future work of the consortium. Therefore, the partners invited to discussions and agreements were not limited to the partners with resources in the relevant work packages.

Besides the interest of contributing partners, a stakeholder survey was performed to help identifying most promising applications. One major part of the survey addressed the stakeholder's assessment in this regard. Therefore, the given selection is not only reasoned by the interest of involved partners but also by the interests and assessments of involved stakeholders. The survey has been performed jointly driven by one representative per work package WP22, WP32, and WP42.

The outcome of the selection process is a list of basic technologies, applications, enablers, and use cases. While first two could be assumed to be fixed and to be analysed and developed within the project, the use cases and enablers are loosely collected and needs further integration and consolidation.

In general, a lot of work items ran in parallel in the sub-projects. Therefore, it must be stated, that the descriptions are not yet perfectly aligned and that implicit requirements from applications to underlying technologies are not necessarily targeted. This will be addressed in the next step of the project, when requirements are collected.

The executed survey did also address questions, which go beyond the selection process. The feedback on those will help the consortium to target specific needs and concerns of stakeholders. Moreover, the stakeholder-related activities included aspects that considered project needs, which are not only related to the involved work packages. Thus, the cross-sub-project activities are the beginning of all stakeholder related activities within TEAM and a group of contributing partners has been found here.

The deliverable D1.0 constiutes the first milestone of the TEAM project and is basis to subsequent actions. This is in particular the definition of requirements and the specification of the system and the architecture. TEAM test sites have already discussed the deployment of the applications. At this moment a final decision can not be made, since the deployment depends heavily on the detailed specification of the TEAM system.

List of abbreviations and acronyms

Abbreviation	Meaning
(eco)CAM/DENM	Special form of CAM/DENM message for ecological information exchange
11p	See 802.11p
2G	2nd generation mobile communication standard, GSM
3G	3rd generation mobile communication standard, UMTS
3GPP	3rd Generation Partnership Project, unites telecommunications standard development organizations (ARIB, ATIS, CCSA, ETSI, TTA, TTC)
4G	4rd generation mobile communication standard, LTE
802.11p	See IEEE 802.11p
ACC	Adaptive cruise control
ADAS	Advanced driving assistance system
AIDE European project	European project, Adaptive Integrated Driver-vehicle InterfacE, http://www.aide-eu.org
AKTIV	German research iniative, Adaptive and Cooperative Technologies for the Intelligent Traffic, http://www.aktiv-online.org/english/projects.html
API	Application programming interface
Application	Group of eventually distributed functions which cause a system to perform useful tasks which are recognizable to the end user, see Section 1.2.2
ASTM E2213-03	Standard Specification for Telecommunications and Information Exchange Between Roadside and Vehicle Systems — 5 GHz Band Dedicated Short Range Communications (DSRC) Medium Access Control (MAC) and Physical Layer (PHY) Specifications
Automotive cloud	Distributed storage and computing systems dedicated to automotive systems
B2B	Business to business
Basic technologies	Fundamental technologies required by applications, refers in TEAM context to technologies developed by EMPOWER, see Section 1.2.1
C-ITS	Collaborative intelligent transport systems

Abbreviation	Meaning
C2C	Car to Car
C2I	Car to Infrastructure
C2X	Car to Car / Car to Infrastructure
CA (certificate authority)	Certificate authority, certificate issueing entity
CA (communication agent)	Communication agent, see Section 3.3.4.5.
CACC	Collaborative adaptive cruise control, see Section 5.3.1
CALM	Communications access for land mobiles, http://www.isotc204wg16.org/concept
CAN bus	Controller Area Network bus, vehicle network
CCA	Co-modal coaching with support from avatar
CCTV	Closed Circuit Television
CDM	Collaborative driving and merging
Chromaroma	London based public transport online game, http://www.chromaroma.com/
citylog	CITYLOG European project, http://www.city-log.eu/
CLM	Cooperative Localization Message, see Section 3.3.1
Cloud	Distributed storage and computing systems
CMC	Collaborative pro-active inter-urban monitoring and ad-hoc control
CO2	Carbon dioxide
CODIA	Impact assessment study for cooperative systems, http://www.cvisproject.org/en/links/codia.htm
COMeSafety (2)	European support action, http://www.comesafety.org.
CONAV	Collaborative eco-friendly navigation
COPLAN	Collaborative co-modal route planning
CoVeL	Cooperative Vehicle Localization for Efficient Urban Mobility, http://www.covel-project.eu/
CPTO	Collaborative public transport optimization
CSE	Community services enablers, set of functions allowing to receive, validate and publish a series of contents, generated by a community of users, about mobility issues/conditions
CSI	Collaborative smart intersections for intelligent priority

Abbreviation	Meaning
CVIS	European research project, Cooperative vehicle.infrastructure systems, www.cvisproject.org
Datex 2 / Datex II	DATEX II TS 16157 1-3, Standard for communicating and exchanging traffic information, http://www.datex2.eu/
DC	Collaborative dynamic corridors
DIALOGUE	Sub-project of TEAM, SP4.
DRIVE C2X	European research project, http://www.drive-c2x.eu
DSRC	Dedicated short range communication
EASY-C	German project EASY-C, http://www.easy-c.de/index_en.html
EC	European Commission
eCall	Emergency Call, European initiative intended to bring rapid assistance to motorists involved in a collision anywhere in the European Union. The eCall initiative aims to deploy a device installed in all vehicles that will automatically dial 112
ECDSA	Elliptic Curve Digital Signature Algorithm
Eco Assistant	Driver assistant system for ecological driving.
Eco Pro	BMW assistant system for ecological driving, http://www.bmw.com/com/de/insights/technology/efficientdynamics/phase_1/measures_ecopro.html
eco:Drive	FIAT assistant system for ecological driving, http://www2.fiat.co.uk/ecodrive/
eco:Ville	Online community for FIAT customers using the eco:Drive product, see eco:Drive.
EcoGuide	Ford assistant system for ecological driving.
ecoHMI working group	working group in eCoMove project
eCoMove	European research project, www.ecomove-project.eu/.
EDAS	EGNOS Data Access Service
EFP	Collaborative eco-friendly parking
EGNOS	European Geostationary Navigation Overlay Service
ELGG	Open source social networking engine, http://elgg.org/
EMPOWER	Sub-project SP2 of TEAM
Enabler	Used for data or aggregated data, tools and algorithms to be used by the applications, see Section 1.2.3

Abbreviation	Meaning
eNodeB	E-UTRAN Node B, hardware part in UMTS networks
ESoP	European Statement of Principleson human machine interface, http://euroalert.net/en/news.aspx?idn=7680
ETIS ITS G5	Set of protocols and parameters for European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band
ETSI	European Telecommunications Standards Institute
ETSI ITS	European Telecommunications Standards Institute Intelligent Transport System
ETSI TS 102 636	Family of documents defining GeoNetworking
European CEN	European Committee for Standardization
EVALUATION	Sub-project SP5 of TEAM
FCD	Floating car data; data and information collected by probe vehicles, typically speed and position
FDD	Frequency Division Duplex, variant of LTE technology
FLEX	Sub-project SP3 of TEAM
FOT	Field Operational Test
G5	Set of protocols and parameters for European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band
GaLA	Games and Learning Alliance, http://www.galanoe.eu/
Galileo	GNSS built by EU and European Space Agency, similar to US-american GPS
Geo-casting	Delivery of information to a group of destinations in a network identified by their geographical locations
GeoNet	GeoNet European Project, http://www.geonet-project.eu/
GeoNetworking	Networking including georouting
GMSA	GSM Association of mobile operators and related companies devoted to supporting the standardising, deployment and promotion of the GSM mobile telephone system
GNBTPAPI	GeoNetworking/BTP API, a software component developed in DRIVE C2X project
GNSS	Global navigation satellite system

Abbreviation	Meaning
GPS	Global Positioning System, a GNSS developed by US Department of Defense
GSM	Global System for Mobile Communications, ETSI 2nd generation mobile communication standard
HARDIE Guidelines	Harmonisation of ATT Roadside and Driver Information in Europe Design Guidelines Handbook, DRIVE II Project V2008, Deliverable No. 20
HCI	Human computer interaction
HMI	Human machine interface
HPSA+	High speed packet access, extension to HPSA
HSDPA	High speed downlink access, extension to UMTS, part of HPSA protocol family
HSPA	High speed packet access, extension to UMTS communication technology
HSUPA	High-Speed Uplink Packet Access, extension to UMTS, part of HPSA protocol family
HTML5	Hyper Text Markup Language 5. Markup language for structuring and presenting content for the World Wide Web and a core technology of the Internet
HW	Hardware
I-GEAR	European research project, Incentives and Gaming Environments for Automobile Routing
I2I	Infrastructure to infrastructure communication
I2V	Infrastructure to vehicle communication
ICE	Internal combustion engine
IEEE	Institute of Electrical and Electronics Engineers
IEEE 1609	Higher layer standard based on the IEEE 802.11p
IEEE 802.11p	Approved amendment to the IEEE 802.11 standard to add wireless access in vehicular environments (WAVE)
IMS	IP Multimedia subsystem
IMT-2000	International Mobile Telecommunications-2000. 3G technology comply with IMT-2000.
IMT-Advanced	International Mobile Telecommunications-2000. 4G technology comply with IMT-2000.

Abbreviation	Meaning
INTIME	European research project, Intelligent and efficient travel management for European cities, http://www.in-time-project.eu
INVENT	German research initiative, Intelligent traffic and userfriendly technology, http://www.invent-online.de/
IP	Internet protocol
ISO	International Organization for Standardization
ISO TC 204	ISO Technical committee, is responsible for the overall system aspects and infrastructure aspects of intelligent transport systems, http://www.iso.org/iso/iso_technical_committee?commid=54706
iTRETRIS	European research project, Integrated Wireless and Traffic Platform for Real-Time Road Traffic Management Solutions, www.ict-itetris.eu/.
ITS	Intelligent Transportation Systems.
ITS 2.0	Product by Telecom Italia.
ITS G5A	Operation of ITS-G5 in European ITS frequency bands dedicated to ITS for safety related applications in the frequency range 5,875 GHz to 5,905 GHz
ITS station	According ETSI EN 302 665, there are four ITS stations: Personal ITS stations, Vehicle ITS stations, Roadside ITS station, and Central ITS station
ITS-g5	Set of protocols and parameters for European profile standard for the physical and medium access control layer of Intelligent Transport Systems operating in the 5 GHz frequency band.
ITSA	Intelligent Transportation Society of America
ITU	International Telecommunication Union
ITU-R	International Telecommunication Union Radiocommunication Sector
Ko-PER	German research project Ko-PER, http://ko-fas.de/deutsch/ko-per---kooperative-perzeption.html.
LDM	Local dynamic map
LDM++	TEAM concept based on the LDM
Local Dynamic Map	Concept developed in the SAFESPOT project. It is a data store located within an ITS station containing information which is relevant to the safe and successful operation of ITS applications.
LOS	Level of service

Abbreviation	Meaning
LSTI	LTE/SAE Trial Initiative alliance founded as a global collaboration between vendors and operators with the goal of verifying and promoting the new standard. Scope to ensure the global introduction of the technology as quickly as possible
LTE	Long-term evolution, marketed as 4G LTE. Standard for wireless communication of high-speed data for mobile phones and data terminals.
LTE/SAE Trial Initiative	See LSTI
M453	European Commission Mandate M/453. It invites the statdardisation bodies CEN, CENELEC and ETSI to prepare a coherent set of standards specifications and guidelines to support European Community wide implementation and deployment of Cooperative ITS
MAC	Media access control
MANET	Mobile ad-hoc network
MM-wave	Millimeter wave: Extremely high frequency is the highest radio frequency band, a form of electromagnetic radiation. Upcoming Wi-Fi standard IEEE 802.11ad will run on the 60 GHz band
MNO	Mobile-Network Operators
Mobilitätsdatenmarktplatz	Oline portal to exchange mobility data, http://www.mdm-portal.de
MTC	Machine-type communication
NFC	Near field communication
O/D	Origin/Destination
OBD	On-board diagnostics
OBD2	OBD2 or OBD-II is an improvement over OBD (OBD-I) in capacity and standadisation
OBU	On-board unit
OEM	Original Equipment Manufacturer
OS	Operating System
P2P	Pedestrian to Pedestrian
PC	Personal Computer
PHY	Physical layer according to OSI model
Physical Storage Format	Layout format describing how map data is stored on a physical device

Abbreviation	Meaning
PKI	Public key infrastructure
POI	Point of Interest
PRE-DRIVE C2X	European research project, Preparation for Driving implementation and Evaluation of C-2-X communication technology
PSAP	Public Safety Answering Points
PSF	Physical Storage Format
PSOBU	Public Safety OBU, a vehicle with capabilities of providing services normally offered by RSU
QoS	Quality of Service
RAN	Radio Access Network
RED-like algorithm	Refers to Random early detection algorithm.
REST architecture	Representational State Transfer (REST) architecture, a style of software architecture for distributed systems such as the World Wide Web
RESTful	Applications or services conforming to the REST constraints
RFID	Radio-Frequency Identification
roadside unit	Equivalent to ITS Roadside station.
RSU	Road-Side-Unit, equivalent to ITS Roadside station
RSUO	RSU Operators
S.I.MO.NE	s.i.mo.ne floating car, http://simone.5t.torino.it/
S.I.MO.NE protocol for FCD	s.i.mo.ne floating car data exchange protocol, http://simone.5t.torino.it/
SaaS	Software as a Service
SAFESPOT	EU SAFESPOT project, http://www.safespot-eu.org/
Serious gaming	game designed for a primary purpose other than pure entertainment, main purpose is to train or educate users
SG	Serious Gaming
SG-CB	Serious Gaming and Community Building
SG-CB	Serious gaming and community building
SHF	Stakeholder Forum
Short Range Communication	Generic term for three incompativle different short-range communication standards in Europe, USA and Japan

Abbreviation	Meaning
simTD	German project sichere intelligente mobilität - Testfeld Deutschland, http://www.simtd.de
SIRI	Service Interface for Real Time Information, model for real time public transport data exchange, http://www.kizoom.com/standards/siri/
SP	TEAM sub-project
SP2/SP3/SP4/SP5	TEAM sub-projects EMPOWER/FLEX/DIALOGUE/EVALUATION
SPaT	Signal phases and timing of traffic lights
SPITS	Strategic Platform for Intelligent Traffic Systems, http://www.cvisproject.org/en/news/spits_the_strategic_platform_for_intelligent_traffic_systems.htm
Stakeholder Forum	TEAM initative to exchange with stakeholders of the TEAM project and TEAM technologies.
Sunset	Sunset EU Project, http://sunset-project.eu/
SW	Software
TD-LTE	Synonym for TDD LTE variant
TDD	Time Division Duplex, variant of LTE technology
TEAM	Tomorrows Elasic Adaptive Mobility project, https://www.collaborative-team.eu/
TECH Group	Basic technology group, group of partners within TEAM with special knowledge or interest regarding a basic technology
TMC	Traffic Management Centre
TMC	Traffic Message Channel, technology for delivering traffic and travel information to motor vehicle drivers
TMS	Traffic Management Systems
TPEG UML	Transport Protocol Experts Group Unified Modeling Language, standardized modeling language to describe conceptual content
TSS Aimsun	Transport Simulation Systems Aimsun, integrated transport modelling software
TwinLin	TwinLin project of Hamilton Institute, Fraunhofer Fokus and TU Berlin, http://www.hamilton.ie/twinlin/
UC	Use case

Abbreviation	Meaning
UMTS	Universal Mobile Telecommunications System, 3rd generation mobile cellular system for networks based on the GSM standard, developed and maintained by the 3GPP
US DoT	Department of Defense of the United States of America
USB	Universal Serial Bus, data exchange standard for wired connections
V2I	Vehicle to Infrastructure
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to Vehicle / Vehicle to Infrastructure
V2X-Vehicle-Network-Bridge	Enabler providing access to vehicle sensors and functions, see Section 5.3.1
VANET	Vehicular Ad Hoc Network
VDV 452	Verband deutscher Verkehrsunternehmen (association of German traffic companies) Schrift 452, document describing an interface for route network and schedule exchange for public transport
Vehicle-API	API to access sensors and functions of a vehicle
VII	Vehicle Infrastructure Integration, initiative fostering research and applications development for a series of technologies directly linking road vehicles to their physical surroundings in order to improve road safety
Voice over LTE	voice communication delivery over LTE networks
VSimRTI	V2X Simulation Runtime Infrastructure, comprehensive framework for the assessment of new solutions for Cooperative Intelligent Transportation Systems, http://www.dcaiti.tu-berlin.de/research/simulation/
WAVE	Wireless Access in Vehicular Environments, IEEE 1609 family of standards on top of IEEE 802.11p
Waze	Free social GPS application featuring turn-by-turn navigation, http://waze.com/
WCDMA	Wideband Code Division Multiple Access, UMTS air interface standard
WG HMI	TEAM working group for human machine interface
WHO	World Health Organization
Wi-Fi	Wireless LAN technology based on IEEE 802.11 standard

Abbreviation	Meaning
WiMAX2	IEEE 802.16m-2011, also known as Mobile WiMAX Release 2, standard for Wireless Metropolitan Area Networks
WP	TEAM work package
WPxy	TEAM work package x.y
xFCD	Extended Floating Car Data

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