simpli·city

The Road User Information System Of The Future

WP2 – Vision and Requirements

D2.2: Target Market Sector Descriptor

Deliverable Lead: SRM

Contributing Partners: SRM, TUV, TIE, IBM, FGM, TALK, TEMP, CRF

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This document performs a description of the target market sector to help maximize the potential SIMPLI-CITY exploitation.

This definition will be used to specify the scope of the RTD and the goal of the prototypes and also to ensure that SIMPLI-CITY does develop technical solutions and services that are actually needed – and used – by the target audience. The definition will also be used as input for the evaluation in WP7 and WP8.

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Executive Summary

The purpose of this SIMPLI-CITY deliverable D2.2 Target Market Sector Descriptor is to describe the current market sector for SIMPLI-CITY in order to maximize future exploitation opportunities.

The document is divided into six chapters and, apart from introduction and references, four main parts.

The first main part is represented by Section 2 where the different topics concerned by the project are explored in the form of mobility and applied technology.

The first part of Section 2 gives an overview of mobility data related to passengers, modal split and population trends as well as of the European automotive industry trends, in order to frame the issue of mobility in its broader aspects. In the second part of Section 2 the technology applied to mobility is assessed under the point of view of Infrastructure Technology Systems (ITS), applications, smartphones, and automotive.

The second core part is represented by Section 3 that undertakes the analysis of products and players at SIMPLI-CITY level by describing in detail the main outputs expected by the project (data system and end users apps) and the role of stakeholders and other players. The mobile sector, the automotive perspectives as well as other European projects' output are appraised in order to find potential opportunities and possible cooperation.

Another key contribution is given by the four Use Cases as presented in Section 4, highlighting the potential market sectors and stakeholders targeted. The analysis seeks to classify potential challenges faced by the use cases and investigate areas where SIMPLI-CITY can be applied to address specific concerns within the mobility sector.

As a conclusion of all the crossed analysis conducted, the deliverable's main aim is well reported in SIMPLI-CITY Strategy, Section 5, where a weighted planning approach is drafted making considerations about the relation between SIMPLI-CITY and the market. The result is a future business sampling that takes into account the potential of the project itself and the continuous evolution of mobility and technology applied to mobility fields. Following emerging needs, both the concerned fields require continuous updating and vision towards the future in order to develop useful and efficient services, and even anticipatory.

Table of Contents

1 Introduction

SIMPLI-CITY – The Road User Information System of the Future – is a project funded by the Seventh Framework Programme of the European Commission under Grant Agreement No. 318201. It provides the technological foundation for bringing the “App Revolution” to road users by facilitating data integration, service development, and end user interaction.

Within this supplement document, a definition of common terms and roles related to the realization of SIMPLI-CITY as well as a list of abbreviations and short names is provided.

1.1 SIMPLI-CITY Project Overview

Analogously to the “App Revolution”, SIMPLI-CITY adds a “software layer” to the hardware-driven mobility “product”. SIMPLI-CITY will take advantage of the great success of mobile apps that are currently being provided for operating systems such as Android, iOS, or Windows Phone. These apps created new opportunities and even business models by making possible for developers to produce new applications on top of the mobile device infrastructure. Many of the most advanced and innovative apps have been developed by players formerly not involved in the mobile software market. Hence, SIMPLI-CITY will support third party developers to efficiently realise and sell their mobility-related services and app ideas by a range of methods and tools, including the Mobility Services and Application Marketplaces.

In order to foster the wide usage of those services, a holistic framework is needed which structures and bundles potential services that could deliver data from various sources to road users information systems. SIMPLI-CITY will provide such a framework by facilitating the following main project results:

- Mobility Service Framework: A next-generation European Wide Service Platform (EWSP) allowing the creation of mobility-related services as well as the creation of corresponding apps. This will enable third party providers to produce a wide range of interoperable, value-added services and apps for drivers and other road users.
- Mobility-related Data as a Service: The integration of various, heterogeneous data sources like sensors, cooperative systems, telematics, open data repositories, people-centric sensing, and media data streams, which can be modelled, accessed, and integrated in an unified way.
- Personal Mobility Assistant: An end user assistant that allows road users to use the information provided by apps and to interact with them in a non-distracting way – based on speech dialogue realized by means of speech recognition and text to speech technologies. New apps can be integrated into the Personal Mobility Assistant in order to extend its functionalities for individual needs.

To achieve its goals, SIMPLI-CITY conducts original research and applies technologies from the fields of Ubiquitous Computing, Big Data, Media Streaming, the Semantic Web, the Internet of Things, the Internet of Services, and Human-Computer Interaction. For more information, please refer to the project Website www.simpli-city.eu.

1.2 Deliverable Purpose, Scope and Context

The purpose of this document is to provide the reader of the SIMPLI-CITY deliverables with supplementary information related to the target audience and the target market

sector. This deliverable will perform a description of the target market sector in order to specify the scope of the research that will be conducted and the goal of the prototypes, and also to ensure that SIMPLI-CITY does develop technical solutions and services that are actually needed – and used – by the target audience. The definition of targets will receive some early inputs from WP7 and WP8, where the use case scenarios are further specified.

1.3 Document Status and Target Audience

This document is listed in the Description of Work (DoW) as “public” since it provides general information about the goals and scope of SIMPLI-CITY and can therefore be used by external parties in order to get according insight into the project activities.

While the document primarily aims at the project partners, this public deliverable can also be useful for the wider scientific and industrial community. This includes other publicly funded projects, which may be interested in collaboration activities.

1.4 Abbreviations and Glossary

A definition of common terms and roles related to the realization of SIMPLI-CITY as well as a list of abbreviations is available in the supplementary document “Supplement: Abbreviations and Glossary”, which is provided in addition to this deliverable.

Further information can be found at www.simpli-city.eu.

1.5 Document Structure

This document is broken down into the following sections:

- Section 1 provides an introduction for this deliverable including a general overview of the project, and outlines the purpose, scope, context, status and target audience of this document.
- Section 2 provides a general overview of the Mobility situation in Europe, analyses the state of the art of mobile technologies and mobile market penetration and studies real connection between Mobility and Mobile.
- Section 3 provides an analysis of the target market sector, assessing the role of stakeholders and actors involved as well as information sources and data and services provided.
- Section 4 highlights case studies presented by the user partners, providing an analysis of their mobility environment. It identifies the impact areas and the market needs for each use case.
- Section 5 goes deeper into the analysis of the market sector to develop the SIMPLI-CITY strategy, looking at the influencing factors.

2 Current Market Analysis

2.1 The Current State of Mobility at European Level

"*In 2010, total passenger transport activities in the EU-27 by any motorized means of transport are estimated to have amounted to 6,424 billion passengers per kilometres (pkm) or on average 12,869 km per person. This figure includes intra-EU air and sea transport but not transport activities between the EU and the rest of the world. Passengers cars accounted for 73.7% of this total, powered two-wheelers for 1.9%, buses & coaches for 7.9%, railways for 6.3% and tram and metro for 1.4%*".

This is the result of a research conducted by the European Commission [EC12], which also shows a growing trend of journeys by passenger car: the number of pkm has increased from 1995 to 2010 by 1.3% per year. With regard to individual mobility, European citizens are in the second place, behind America, but far in front of Japan, China and Russia (cf. Table 1: Passenger Transport, in billion pkm [EC12]).

With regards to freight, the situation is quite similar: road-based freight transport shows a strong growth, while rail transport has been substantially steady over the last 15 years. Only from 2007 to 2009 the number of tons delivered decreased for all means of transport, but since then it has increased again (cf. Figure 1: EU-27 Performance by Mode, 1995-2010 [EC12]).

Table 1: Passenger Transport, in billion pkm [EC12]

	EU-27 (2010)	USA (2009)	Japan (2010)	China (2010)
Passenger car	4,738	5,828.4	766.7	1,491.4
Bus + trolley-bus + coach	510.1	490.1	87	n.a.
Railway	403.8	40.1	393	876
Tram + metro	90.1	17.9		n.a.
Waterborne	38.1	0.6	4.3	7.2
Air (domestic / intra-EU-27)	524.2	887.9	73.8	403.2

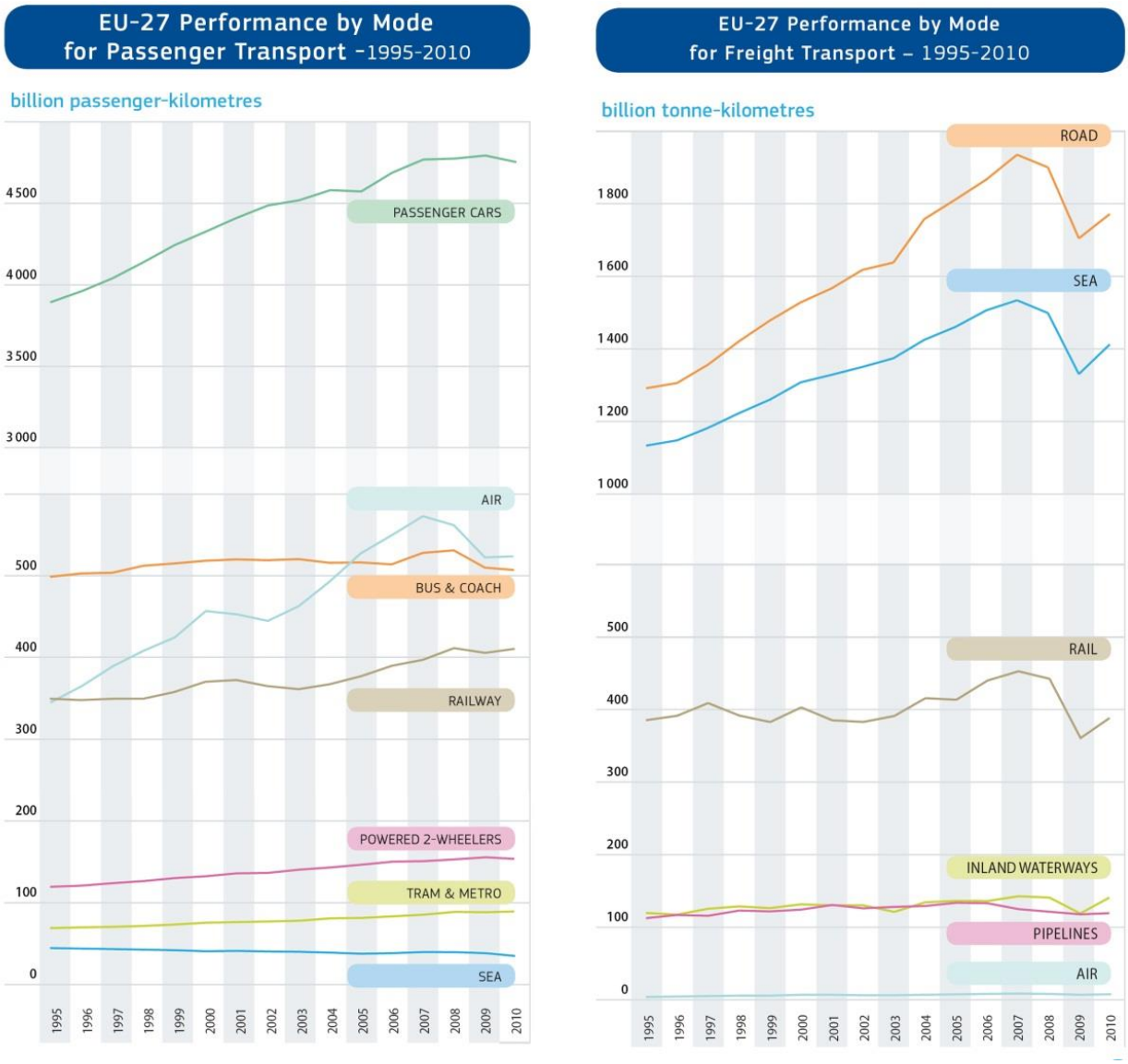


Figure 1: EU-27 Performance by Mode, 1995-2010 [EC12]

Increasing mobility needs in people's life are therefore met by increased use of (individual) motorized road transport.

It is also important to evaluate the demographic situation, since the need for mobility is strongly linked to and influenced by it.

The "Department of Economic and Social Affairs" of the United Nations provided some prediction about the future demographic development. With regard to Europe, the total population will decrease by 2.5% in the next 40 years (cf. Figure 2: Population Trend 2010-2050 [UN11]), while the demographic distribution between urban and rural areas is moving toward cities (cf. Figure 3: Urban vs. Rural Population 1950-2050 [UN11]): by 2050 the population living in urban areas will be 80% of the total population.

This is probably the most important and affecting prediction on mobility needs, in particular, if related to mobility problems such as traffic congestion, pollution and waste of time in driving, all expected to be increased. Indeed, the combined growth in private car use and urbanization of population will result in a growth in road traffic levels in urban areas.

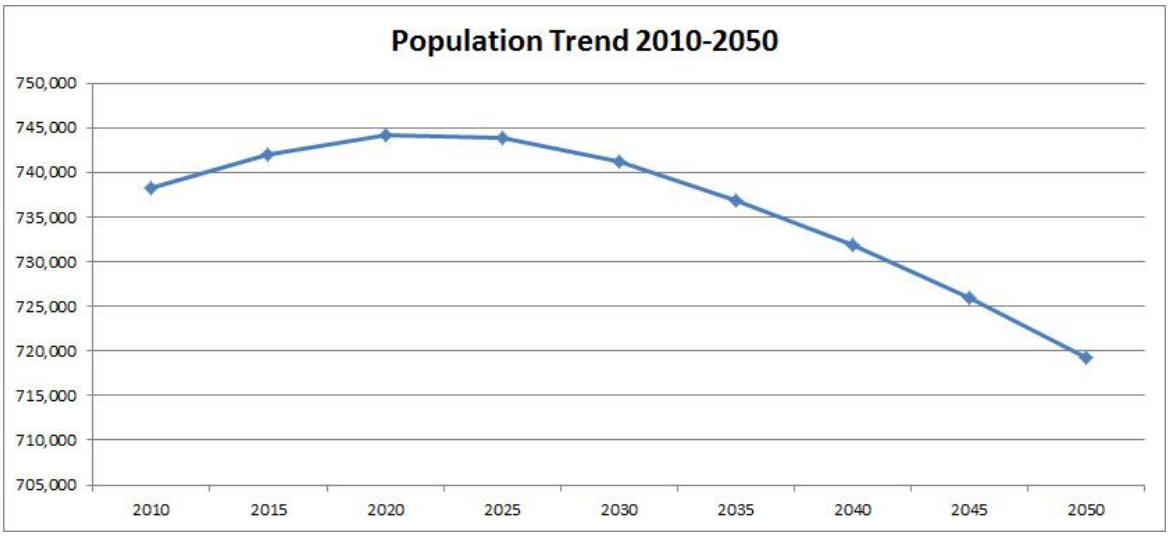


Figure 2: Population Trend 2010-2050 [UN11]

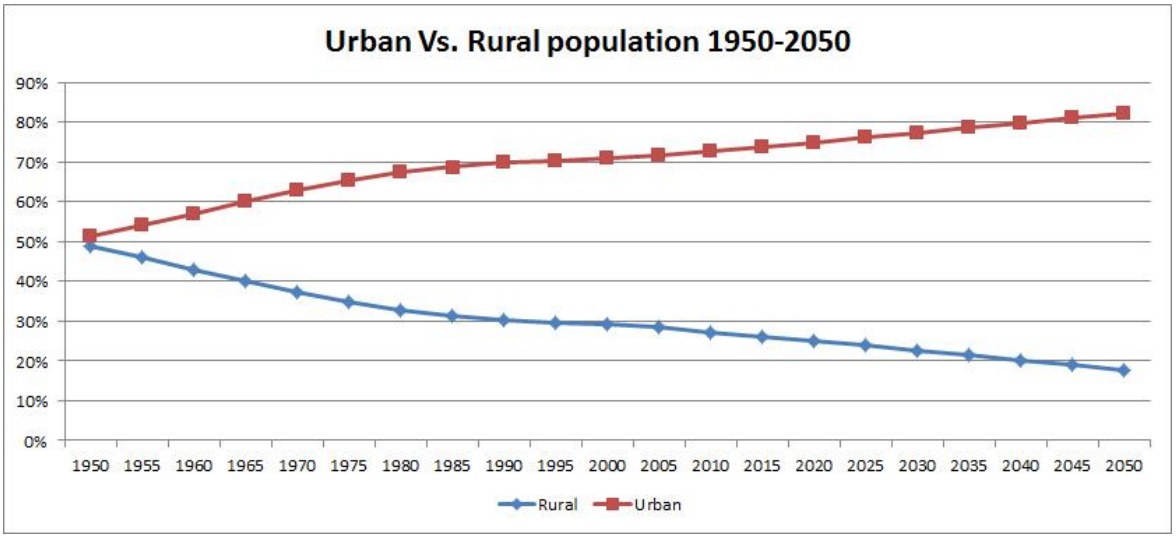


Figure 3: Urban vs. Rural Population 1950-2050 [UN11]

Considering the modal split in different European cities (cf. Figure 4: Modal Split in Selected European Cities. Years: Bologna (2001), Barcelona (2006), Paris/Sofia/Darmstadt (2008) [EPO11].) and the population trend in urban environment (cf. Figure 3: Urban vs. Rural Population 1950-2050 [UN11]), it can also be envisaged that urban mobility demand will increase in the next few decades.

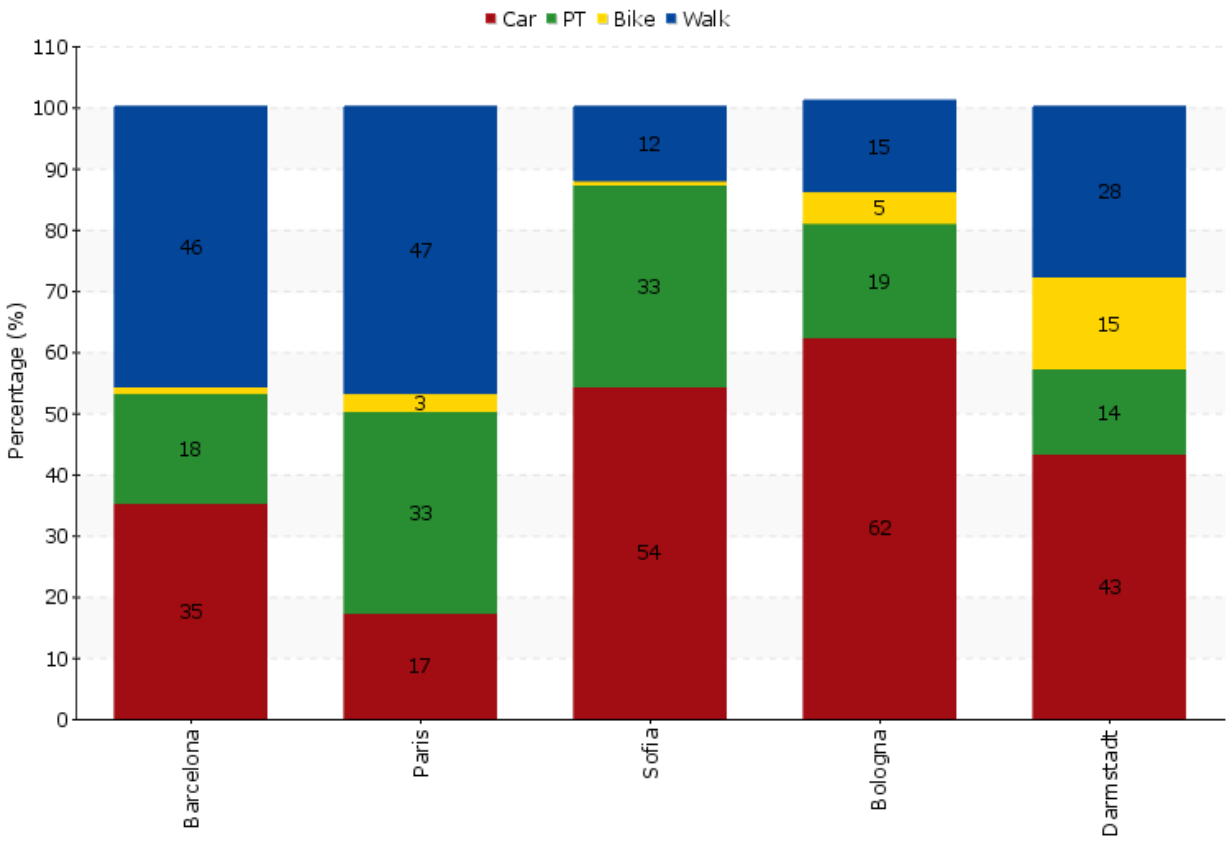


Figure 4: Modal Split in Selected European Cities. Years: Bologna (2001), Barcelona (2006), Paris/Sofia/Darmstadt (2008) [EPO11].

Additionally to the general trend and average mobility patterns, big events taking place in urban areas (e.g., concerts, sport events, fairs, etc.) are a major trigger for peak volumes of traffic. A Swiss study on the subject matter [Egl04] indicates the following modal split for selected events in Zürich (not having an underground transport system).

Table 2: Modal Split for Selected Events in Zürich [Egl04]

Event/Venue	Public Transport	Individual Transport	Others	Source
Opera “Zauberflöte”, 1999, Hallenstadion	32%	32%	5%	Survey Verkehrsbetriebe Zürich (Zürich Public Transport)
Swisscom Challenge (Tennis Tournament), 1999, Letzigrund	24%	71%	5%	Survey Advantage (Organiser)
Opera “Aida”, 1997, Hallenstadion	42%	49%	9%	Survey Verkehrsbetriebe Zürich (Zürich Public Transport)
Swisscom Challenge (Tennis Tournament), 1998, Letzigrund	27%	67%	6%	Survey Advantage (Organiser)

Although largely dependent on the location of the event, the existing public transport infrastructure, the mobility management measures taken and the type of event, it can be stated that the share of car transport can be considerable at big events and thus also related problems, notably congestion and long cruising in search of parking space, aggravated by clear peak times at the beginning and ending of an event.

One of the objectives of the SIMPLI-CITY project is the study and the development of an effective solution to pave the road for a sustainable mobility for all European citizens.

The current situation of mobility in Europe provides then a fertile ground to test and try new solutions for its improvement, such as the SIMPLI-CITY Platform and the Personal Mobility Assistant (PMA), both focused on reduction of traffic congestion, and on safety, comfort, and eco-friendliness.

In this perspectives, the European automotive industry is a key sector for the European economy, providing over 12 million jobs and a positive contribution to the trade balance of around € 90 billion (in 2011). It is therefore essential for continued European prosperity. A brief overview of the impact of the European automotive industry is shown below Figure 5and Figure 6 based on ACEA (European Automotive Manufacturers' Association) figures..

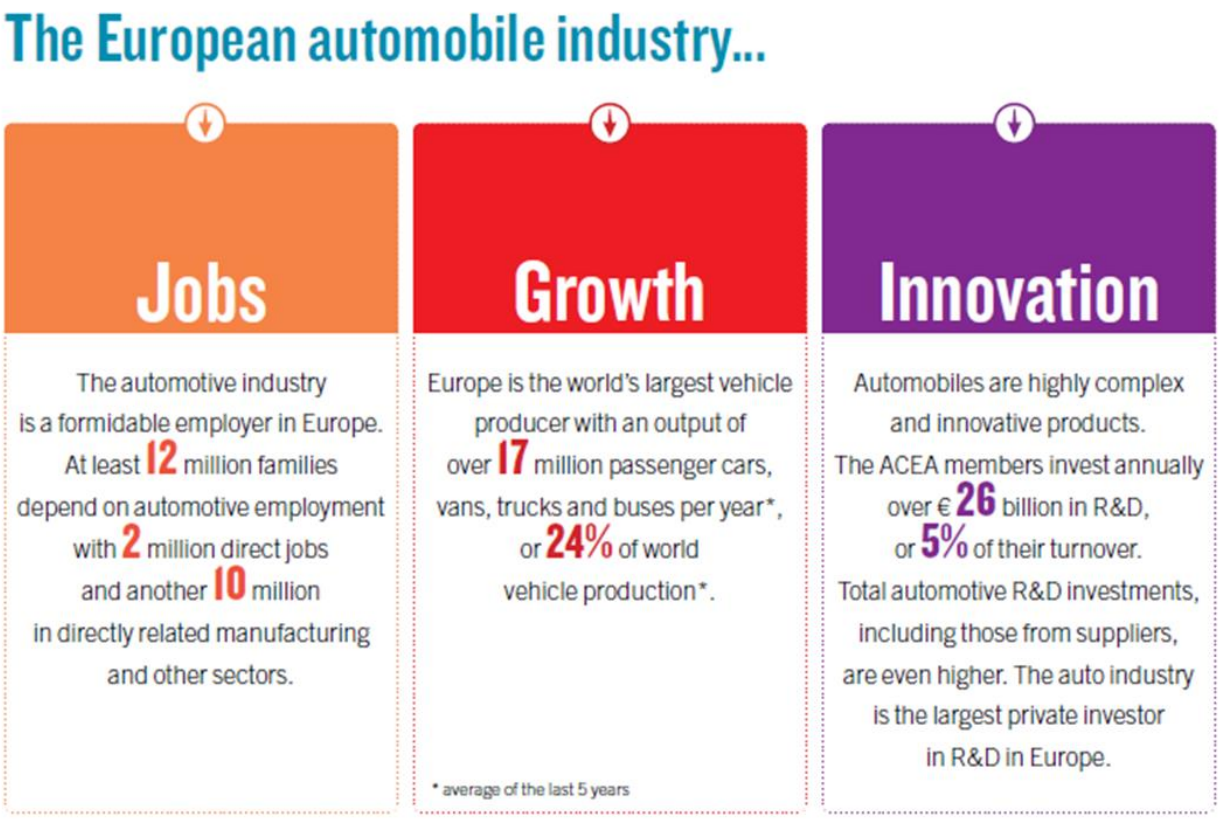


Figure 5: ACEA Key Figures of the European Automotive Industry [ACE12]

Figure 6: ACEA Key Figures of the European Automotive Industry [ACE12]

Therefore, the European industry should provide new vehicles which are cleaner in terms of regulated pollutants, more fuel-efficient, quieter, safer, and connected to meet simultaneously the target of a sustainable mobility and of industrial competitiveness.

At the same time, the issue of reducing CO_2 emissions is probably the most important driver for automotive research over the coming years: the Regulation (EC) No 443/2009, in addition to setting the target of 130 g CO_2/km for new car emissions in the period 2012-2015 also sets a target of 95 g CO_2/km to be achieved by 2020. Reduction of CO_2 emissions can results from the following three actions:

- Enhancing the efficiency of conversion of the energy vector used (i.e. powertrain performance).
- Reducing the global carbon footprint of the energy vector used.
- Reducing the energy used by the vehicle during operation, including integrated approaches that involve the driver and infrastructures.

The latter being fully in line with the SIMPLI-CITY target outcomes.

The following Figure 7 shows the continuing downward trend of CO_2 emissions of new cars.

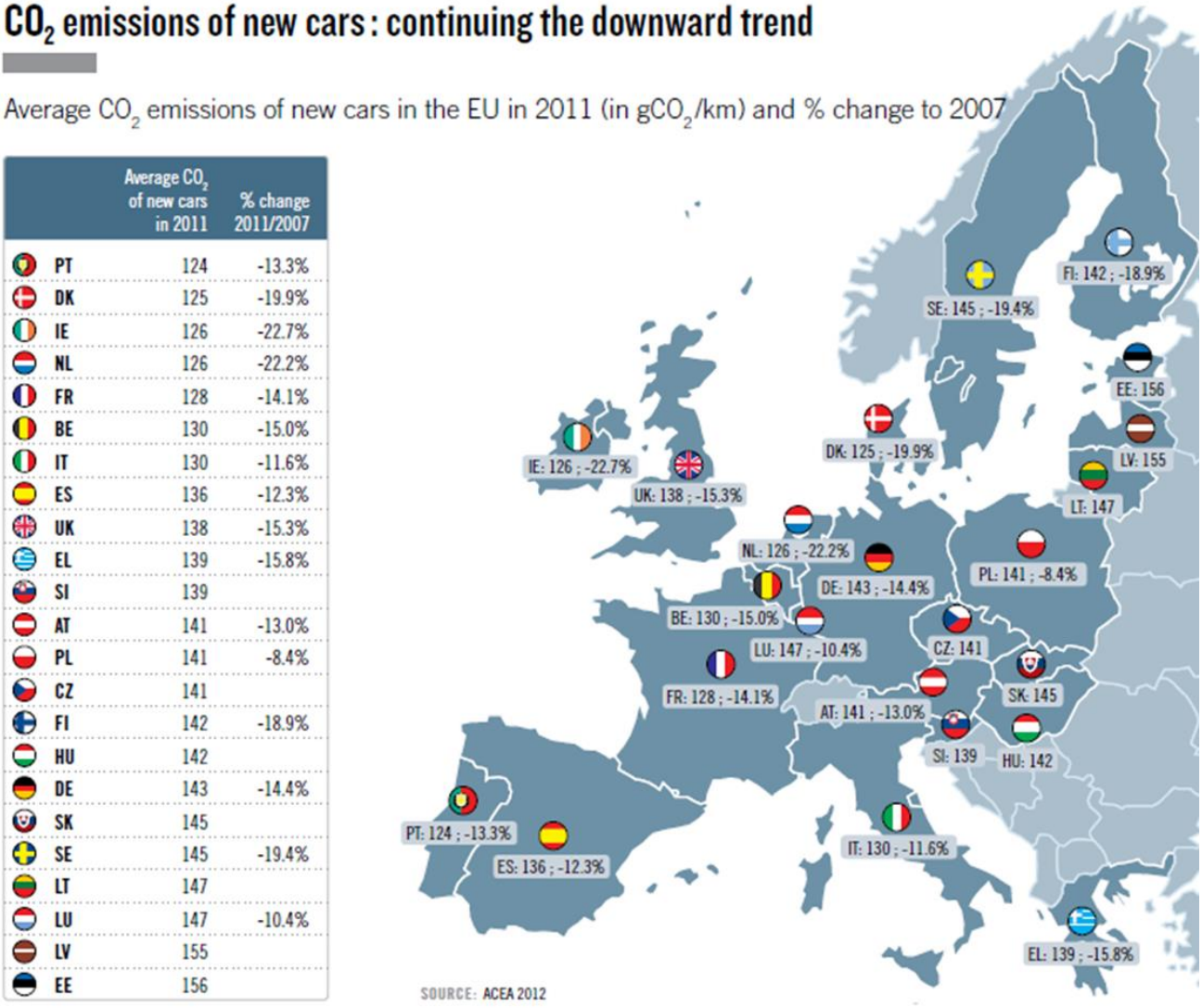


Figure 7: CO_2 Emissions of New Cars [ACE12]

About co-modality of transport, the SIMPLI-CITY project will follow the ACEA definition of co-modality as an efficient individual mobility. In this sense, the co-modality paradigm describes a transport system where, systematically, the most efficient mode of transport is used for each particular transport task, realising that efficiency, rather than a prescription of transport means, will deliver the desired societal, economic, and environmental results. Various modes of transport do not “compete” with each other; rather, opposite modes are complementary because each one serves a different type of mobility demand. For example, when a vehicle is selected by the customer, flexibility and travel time usually make the difference; typical modal choice criteria include travel time, reliability, cost, location and distance.

2.2 The Technology Applied to Mobility

In the last few years, the technological evolution allowed a big change in mobility, both for Local Bodies/Authorities and for road users. From raw data collected by sensors about real-time traffic situation to Variable Message Signs (VMS) providing useful information to

road users, from GPS positioning to real-time parking availability, there are many different examples of Information Technology (IT) applied to mobility.

For example, historical data on mobility trends give the Local Bodies/Authorities a comprehensive awareness of the traffic conditions and of the critical situations. Consequently, data sensors were widespread all around cities, and data they provide are nowadays the basis of many traffic planning activities. The same data can be suitable for road users. They can use IT applications related to real-time routing and remote trip planning, to find the fastest, shortest or less congested route to reach their destination, whether they are car drivers, cyclists, bus users or pedestrians.

Technological systems could be divided into two groups, so they can be better focused and become more recognizable and understandable:

- The first main group is made up of Infrastructure Technology Systems (ITS), and contains any sensor, antenna, device that is part of the road network system. It could be compared to the hardware of a computer.
- A second main group is made up of any application that handles and elaborates data collected by components of the first group.

These groups are tightly connected to each other through a common element, a device able to provide information to road users. The device can be a self-standing one, such as smartphones and tablets, or embedded into a car, which is getting more and more technological and “connected”, both to the web and to the road.

The following sections give a general overview of these features.

2.2.1 Infrastructure Technology Systems

Infrastructure Technology Systems are part of the road networks, and provide useful data which are the basis of the most common transport-related apps. Some examples of them are listed below:

- *Parking*: the number of available spaces within a parking can be monitored by specific sensors located at the parking entrance and the information can be known in real-time by parking operators and provided to road users through specific displays along roads or via web apps.
- *Automatic Vehicle Monitoring* (*AVM)*: it provides vehicle fleet control and allows knowing the real-time position of each vehicle through a GPS transponder installed on it and a data transmission system linked to the control centre. In the last few years, such systems have been installed on many public transport bus fleets, providing on one hand the bus operator with key information about the service status, and on the other hand the user with real-time information about bus service.
- *Detecting Loop*: this system usually consists of electromagnetic sensors within the road pavement, recognizing a vehicle when it passes above them. Some loops can detect also the speed and the size of the vehicle (car or heavy vehicle). Loops can be located along a road arc to detect the number of vehicles passing along it during a unit of time and their speed (the elaboration of this data can estimate the level of traffic and congestion on the road), but can also be located close to traffic lights to detect the length of the queue of vehicles waiting to cross the intersection. These data are used to optimize traffic light phases and reduce queues, but they could be used for re-routing in SIMPLI-CITY use cases.

- *Variable Message Signs (VMS)*: despite the fact that they are not sensors, because they do not collect data, VMS can be included in this group as “hardware” components. VMS displays are located along roads, providing information to road users, such as, for example, the number of available spaces in a parking, details on traffic conditions, or traffic restriction for specific days.

2.2.2 Applications

Navigation systems are a very important category among apps in the mobility domain: geo-referenced touristic maps providing information about interesting places in the city, on-line and off-line turn-by-turn navigation systems, maps dedicated to bike users and to public transport users, tracking systems and route sharing are only some of the many different apps in this category. Maps are also an element of support for other kind of apps, for example the location of hotels on a map (e.g. hotel booking apps), the location of houses on sale (e.g. real estate apps), and the location of shops (e.g. yellow pages apps).

The importance of maps is confirmed by the recent choice of Apple to create their own maps application and abandon Google Maps, which were provided by Apple in its operating system until iOS 5. Nokia created their own map service with OVI Map a few years ago, and it has recently launched the new platform Nokia Maps, and Microsoft is doing the same with Bing.

Navigation systems based on maps, are widely spreading among all smartphone owners. In fact, in the last few years, besides navigator producers such as TomTom, Garmin, etc., which made their own business selling navigation systems to the end users, many navigation apps have been created. Some of them have been created by Local Bodies/Authorities or by service providers (i.e. the *iATM-Milano* App for bus users, the *car2go* App for car sharing, *iBicis Barcelona* for bike sharing service) to offer a useful service to their citizens and costumers. Many others have been created by small software houses and have now a great diffusion among customers.

Furthermore, virtual networking and smartphone apps represent potential solutions that may rationalize road users’ decisions, simplifying multimodal travelling in the cities.

For example, the free navigation and traffic information application “Waze” can be quoted, available for iOS and Android, with community/crowd sourced road map data (29 million users), traffic flow information, traffic alerts, etc.

But also the integration of navigation apps and other smartphones functionalities are becoming deeper and deeper. iOS and Android are integrating their voice controlled personal information agents (Siri and GoogleNow) with apps, making it possible to control by voice their built-in maps (set an address and navigate to it, find Point of Interests (POIs), such as the nearest ATM, café, etc.).

2.2.3 Smartphones

Software, apps and other systems that elaborate data and produce outputs would be useless without an appropriate device able to provide information to road users in a simple, effective, usable and continuous way. Smartphones play exactly this role. In recent years, indeed, smartphones have become part of our daily lives. Irreversibly and day-by-day they are adding new possibilities of communication and interaction. They provide the chance to users to be connected to the web at any time and in any place. Furthermore, the

possibility to access contents and information in real-time makes some processes faster, both for professionals and for daily life users.

The analysis of smartphone penetration among population offers a general overview about how the daily life of people is changing. Data elaborated by “ComScore and Telefonica” show a strong penetration of smartphones in the so called EU5 (Spain, UK, Italy, France and Germany), and a trend of continuous growth.

“*In the EU5, smartphone adoption has reached nearly 42 per cent and an increase of 13 percentage points over the past year. The highest penetrated market is Spain (48.4 per cent), followed closely by the UK (48.1 per cent). In Italy 42.1 per cent of mobile owners used a smartphone, while in France penetration was a bit lower at 38.1 per cent. Germany currently shows the lowest penetration of smartphones with only 34.2 per cent, but the growth rate is the highest amongst the European countries with a 64 per cent increase in the number of smartphone users within the past year.*” (cf. Figure 8: Growth of Smartphone Audience in the EU5 [CT12]).

The possibility to be web connected through smartphones is another important factor to be evaluated, and latest market researches show that “*in October 2011, 76% of smartphone owners in the EU5 were mobile media users, meaning that they browsed the mobile web, accessed applications, or downloaded content. The […] 62% growth in the total number of mobile media users in the past year is largely attributable to the acceleration in smartphone adoption, 3G/4G network quality, and the increasing ubiquity of aggressively priced data plans, all of which facilitate the consumption of mobile media*” [CT12]. This means that about one third of people who own a mobile device can access the Internet from everywhere.

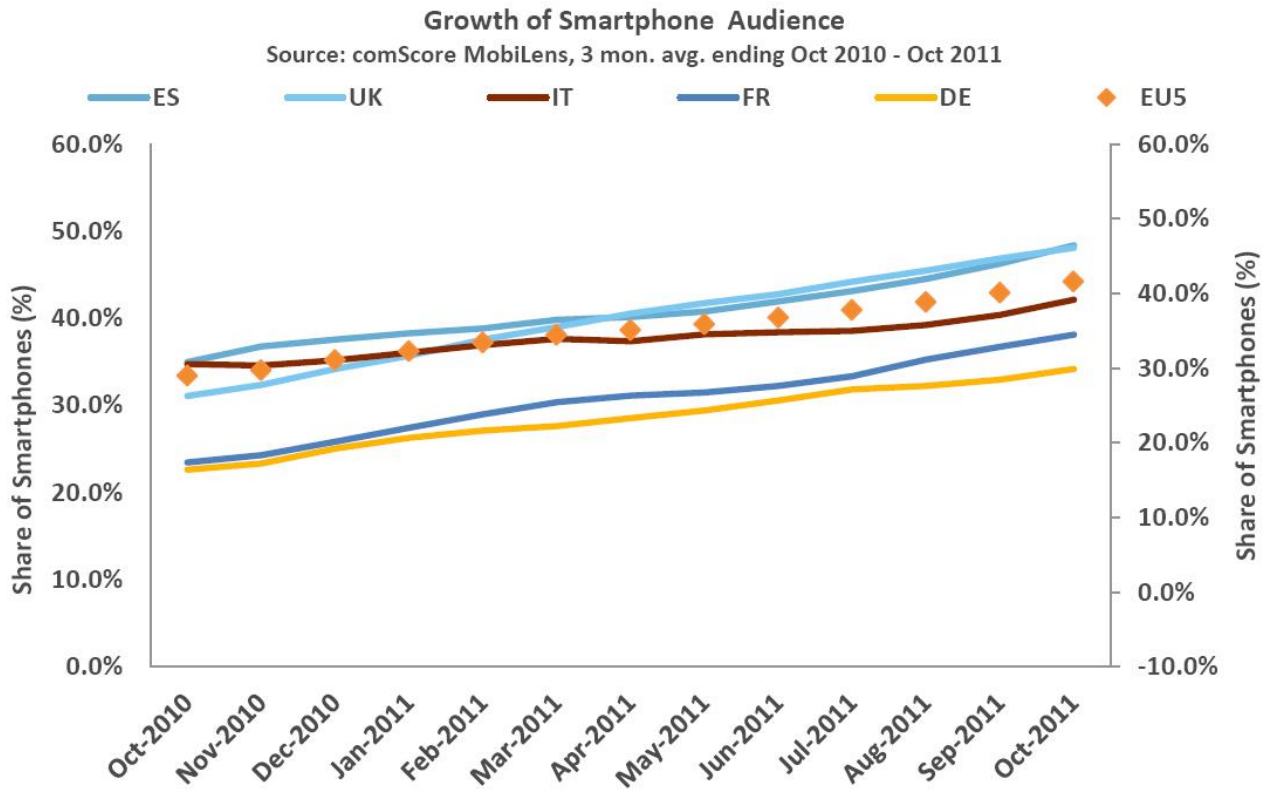


Figure 8: Growth of Smartphone Audience in the EU5

This is a key point, because the wide use of smartphones has led to an exponential increase in the number of available apps: the app counted in the Apple AppStore have increased by ten times from September 2009 to September 2012 (from 75,000 to 700,000), in Google Play Store (former Android Market) the increase has been even higher, from 16,000 in December 2009 to 700,000 in November 2012.

2.2.4 The "Connected Car"

The car is no longer only a means of transport. It is transforming into a vehicle integrated with the traffic management system and can offer a number of on-board traffic related and infotainment based functions.

Several car manufacturers already offer basic connected car systems that allow Internet connection to a vehicle through mobile phone networks. According to Juniper Research - Telematics & Smart vehicles, more than 92 million vehicles with Internet connectivity will be on the road by 2016. Smartphones integrated with vehicle electronic platforms is also expected to fuel the growth.

The future of the connected car is expected to be affected by the availability of apps, in a similar way as it has affected mobile phones market. Connectivity in the car will allow car manufacturers to provide a new driving experience (e.g. ConnectedDrive by BMW, COMAND by Mercedes-Benz, SYNC by Ford, Blue&Me by FIAT and UConnect by FIAT-Chrysler).

On-board connectivity will also enable a new range of business opportunities with a number of stakeholders, like for example:

- *Insurance providers:* the insurance industry will be able to acquire useful data to provide tailored pricing schemes to drivers.
- *Fleet operators and leasing companies*: real-time status information of vehicles and drivers will permit to optimize operations and asset management of businesses that manage fleets of vehicles.
- *Car manufacturers*: car connectivity will enable a vast range of applications such as exchange of safety related information, traffic related data, advanced navigation features, and driver's value added services (e.g. points of interest).

The following elements are expected to leverage car connectivity:

- *Safety*: safety services are of main interest for all citizens. Among them there is the Emergency Call (eCall), which aims to deploy an on-board device that will automatically dial 112 in case of a road accident. The eCall implementation is expected to be mandatory in Europe by 2015.
- *Ad hoc vehicular network:* the availability of communication platforms that will enable 4G and short range communication. Today, standardisation of short range communication is in its finalisation phase.
- *Security*: security services are focused on avoiding or discouraging theft, for example, by making use of GPS technology to locate stolen cars.
- *Convenience*: services like remote vehicle monitoring provide a closer relationship between the customer and the car.
- *Navigation*: this group includes navigation and real-time traffic information services.
- *Infotainment*: cloud-based systems enable consumers to access media and real-time information anywhere and anytime.

2.2.5 Conclusions

Vehicles integrated with smartphones, social networks, and co-modal transportation platforms are changing the way to organize daily life. The ensuing pressure to devise a sustainable and more efficient mobility has resulted in a significant surge in popularity for new forms of smartphone apps for sustainable mobility solutions.

New technologies and mobility tools are challenging opportunities for Local Bodies/Authorities, road users and market operators such as software developers, mobile producers, car manufacturers, etc.

On one hand, Local Bodies/Authorities invest in and demand technologies which may contribute to a more sustainable and effective urban mobility; on the other hand, driven by the road users' increasing requests, market operators generate tools and provide apps collating and developing database information.

3 Target Market Sector

3.1 Approaching the Target Market

SIMPLI-CITY is a complex project aiming at delivering the Road User Information System of the Future. In this meaning, it shall be noted that future cities are becoming bigger and bigger; it is expected to have several mega cities in Europe, and in this light SIMPLI-CITY can become one of the actions towards the creation of smart –big cities of the future.

To reach this aim, the project will move beyond the state of the art in distinct areas: Mobility-related services, service platforms, and integration of heterogeneous, mobility-related data sources.

In such a complex environment, it is necessary to define the Target Market(s) of SIMPLI-CITY, to deeply assess the SIMPLI-CITY "products", the role of the involved stakeholders, the potential end users and the concerned data flows. In particular, with regard to stakeholders, it is important to identify them in detail, group them in homogeneous sectors, and understand their exact roles and relations.

Other concerned actors are existing or in-progress systems, activities, procedures, platforms, apps, etc., which are in some way related to SIMPLI-CITY, and SIMPLI-CITY will study these to find out synergies and possible best practices exchange.

3.1.1 Stakeholders and Users

Stakeholders involved in SIMPLI-CITY development and exploitation could be mainly divided into private and public subjects. The distinction is relevant to understand also the role they play in the mobility domain.

Stakeholders, such as road users, car manufacturers, software houses, Local Bodies/Authorities, etc. can act both as data provider and as data user and can get benefits from both groups at the same time as explained in the next sections.

On one side there are "private" companies, mainly software developers who could benefit from SIMPLI-CITY on the cloud-based data repository to develop their own profitable software. On the same side hardware (car and mobile devices) manufacturers could take advantage of mobility software by providing compatible devices, where mobility apps could be exploited in their full potential.

On the other side there are "public" subjects such as Local Bodies/Authorities and other public bodies, which play two roles: they are data "suppliers", since data coming from their repositories are used and integrated with other data streams in the cloud-based SIMPLI-CITY data platform, and they address the mobility choices of citizens, since data they provide to the platform are essential for the definition of routes. Indeed, the more detailed the data referred to a mean of transport (e.g. scheduled bus, bus stops position, waiting time) are, and the more exhaustive and reliable the information given is, the more encouraged are road users to prefer a mean of transport to others. Of course, the road users themselves could be considered as "public" stakeholders, having benefits from being potential users of the SIMPLI-CITY PMA.

A special "hybrid" subgroup is represented by private subjects able to provide information to the end users. Examples of this category could be shops, theatres, hotels, cinemas,

data streamers, that directly or indirectly (through data brokers) are able to provide large amounts of data related to opening hours, public transport, commercials and infotainment.

3.1.1.1 Information Consumers and Producers

Considering the mobility-related data as “information”, stakeholders could be also classified following an approach based on the direction of information flows. In this case, it makes sense to distinguish between information consumers and information producers.

The road users, in their role of information consumers, use the SIMPLI-CITY PMA or other apps based on SIMPLI-CITY platform and they are able to benefit from all the services and information (e.g., the fastest route to go somewhere, information about opening hours of shops, museums and cinemas, a more comfortable travel in their cars thanks to a performing infotainment service) provided by other subjects (in their role of producers) as the ones described in the previous sections.

In the other “direction”, the way road users use information could be elaborated and returned as a feedback to the original information and services providers. In this case, roles are reversed, because road users become “producers”, while Local Bodies/Authorities and commercial activities of previous examples become “consumers”. Local Bodies/Authorities and commercial activities, in their role of consumers, benefit from the information indirectly provided by road users. Indeed, trip optimization means less pollution and traffic congestion and then they can be considered as results of good mobility policies adopted by Local Bodies/Authorities (which gets benefits); modal choice means a feedback on mobility behaviour of road users and a useful data for future planning activities; the number of route calculations to a commercial activity gives a feedback on the efficacy of some advertising campaign (the commercial activities get benefits as well), etc.

3.1.2 The “Products”: Mobility-related Data and End User Apps

The two main goals of SIMPLI-CITY are:

- To provide PMA and service developers with mobility-related data as a Service.
- To provide end users with mobility-related services on their smartphones and other nomadic devices through end users’ Apps and Personal Mobility Assistant.

In other words, two output groups can be identified:

- The mobility-related data, that will be received by external data sources and then collected, elaborated, integrated, stored and provided as Service by the SIMPLI-CITY platform to PMA and service developers.
- The end user Apps, that allow user interaction through the PMA.

The strong connection between these two groups is very clear, because they are not stand-alone groups but they depend one on each other. At the same time, the distinction between them is also very clear.

In specific, mobility-related data determine the quality of the service provided by SIMPLI-CITY and the potential advantages over the other players: indeed the PMA and any other end user Apps will be fed by data contained in the SIMPLI-CITY platform, so if data are poor or missing the PMA loses the most part of its utility and the platform loses its attractiveness. From a technical point of view, the Work Package 4 *Mobility-related Data as a Service* is intended to provide fundamental data access functionalities to the SIMPLI-CITY project, i.e., the means to describe, provide, discover, exchange, and store data from

various, heterogeneous sources, including cooperative systems, telematics, intelligent infrastructures, sensors and sensor networks, media data streams, open (government) data repositories, or user-centric sensing.

Considering service developers, they are firstly intended as internal to the SIMPLI-CITY partnership. Further opening of data market to external service developers will be evaluated upon requests, according to privacy/openness issues of data gathered and to the scope of such requests. Anyway, the consortium considers the contribution that external developers could provide to the SIMPLI-CITY platform improvement as very valuable: e.g., they may create new apps and services that could extend the functionalities of the SIMPLI-CITY platform and this way increase the value for end users. For this reason, in addition to the previously described output groups, SIMPLI-CITY will also provide support to developers in terms of specific tools and guidelines.

3.2 Target Markets

The two groups of outputs, mobility-related data as a Service and end user Apps, are the starting point of the target market analysis, since the relationship between SIMPLI-CITY and the market will be strictly dealing with them.

Considering that the aforementioned stakeholders and other subjects are the basis and mainly the target of the project, the market strategy of SIMPLI-CITY will be drafted according to them.

3.2.1 Markets and Actors for Mobility-related Data as a Service

In the SIMPLI-CITY project, a big effort will be done on components of the SIMPLI-CITY platform in charge of mobility-related data handling and providing as a Service, because these components are considered to be the core of the whole project.

Mobility-related data consist of data coming from sensors, cooperative systems, telematics, open data repositories, user-centric sensing, media data streams and from road users feedback.

The SIMPLI-CITY platform will collect and pre-process (if necessary) the mobility-related data. Once data are available, the target data market could be identified as service developers that are charged to transform such data into end users apps. The data market is based on several kinds of data suppliers that could operate at different levels such as:

- *Data sources:* raw data are directly collected from the data owners, which can be listed in a non-exhaustive way as follows:
  - Sensor-based data are often made available by Local Bodies/Authorities or by Road Manager Bodies/Authorities such as traffic data providers of any kind, Public Transport Operators, etc.
  - Data coming from open data repositories are often given by City/Regional Bodies/Authorities.
  - Media data streams provided by web based media (for a more detailed analysis of these data sources, please refer to SIMPLI-CITY deliverable D2.1).
  - User-centric data sources, providing context information which can be integrated into added-value end user applications and services.
- *Data collectors (or data brokers):* data collected from intermediary companies or Local Bodies/Authorities that collect raw data themselves from the data owners and

supply large amount of raw data. GoogleMaps, NokiaMaps, ViaMichelin, Open Streetmap are examples of Data collectors.

- *Data developers:* processed data collected from intermediary companies, which have already done some kind of development, as for example information available on Google Transit, or provided by Yellow Pages and returned on a map.

Mobility-related data will be provided as a Service by the SIMPLI-CITY platform to PMA and service developers. The Mobility Service Framework is the component of the SIMPLI-CITY platform in charge of developing, personalising and combining services before these are to be used by the PMA and service developers. Being the interface between the integrated data sources (WP4) and the end user Apps (WP6), the Mobility Service Framework will be the basis for all services and end user Apps facilitated by the project. To guarantee the high quality of such a component, it would be useful to find and study other similar components, which can be found in particular in other European Projects, whose aim is similar to SIMPLI-CITY. It is important for SIMPLI-CITY to find, in some cases, an inter-project cooperation as well as the creation of synergies in general. Some examples for such projects are:

- *i-Tour project (www.itourproject.com)* is an on-going project (from 2010-02-01 to 2013-07-31) funded by the European 7th Framework Programme (FP7) that will develop an open framework to be used by different providers, authorities and citizens to provide intelligent multi-modal mobility services. i-Tour client will support and suggest, in a user-friendly way, the use of different forms of transport (bus, car, railroad, tram, etc.) taking into account user preferences as well as real-time information on road conditions, weather, and public transport network condition. To do so i-Tour promotes a new approach to data collection based on recommender system through the information provided by the whole user community. i-Tour mobility client applications will feature a very user-friendly interface accessible from PCs, PDAs and Smartphones. i-Tour clients are designed to promote use of public transport by encouraging sustainable travel choices and by providing rewarding mechanisms for users choosing public travel options. Sustainable travel preferences, e.g. measured in terms of CO_2 emission saved by using public transport, are rewarded, e.g. through free public transport tickets, thus promoting and encouraging environmental friendly travel behaviours.
- The SUPERHUB project will conclude in 2014-09-30 and it aims at realizing a new services mobility framework supporting an integrated and eco-efficient use of multi-modal mobility systems in an urban setting. SUPERHUB provides a user-centric, integrated approach to multi-modal smart urban mobility systems, through an open platform able to consider in real time various mobility offers and provide a set of mobility services able to address user needs, promote user participation and to foster environmental friendly and energy efficient behavioural changes.
- The INDENICA research project is co-funded by the European Commission within the 7th Framework Programme in the area Internet of Services, Software & Virtualisation (from 2010-10-01 to 2013-10-01). It aims to simplify the overall complexity of service platform development through methods, architectures and tools that support the development of context and domain-specific platforms along with the services. The project targets to support platform convergence and interoperability to avoid the increased dependency on external service and platform vendors and this will be achieved by providing a common basis for families of platforms which integrate system management and interoperability capabilities right

from the start. Finally, it will provide a reusable infrastructure for platform development and support the automatic deployment and the monitoring, governance, and adaptation of services in a Virtual Service Platform.

- *SOA4All Service Oriented Architectures for All* was a Large-Scale Integrating Project (concluded in April 2011) funded by the European 7th Framework Programme, under the Service and Software Architectures, Infrastructures and Engineering research area. SOA4All aimed at realizing a world where billions of parties are exposing and consuming services via advanced Web technology: the main objective of the project was to provide a comprehensive framework to integrate complementary and evolutionary technical advances (i.e., SOA, context management, Web principles, Web 2.0 and semantic technologies) into a coherent and domain-independent service delivery platform.
- *TEXO* is a research project within the THESEUS research program initiated by the German Federal Ministry of Economy and Technology (BMWi). THESEUS aims at developing a new Internet-based infrastructure in order to improve both the usability and practicability of knowledge available on the Internet. Within the THESEUS program, TEXO contributes to the service economy by creating infrastructure components for Business Webs in the Internet of Services (IoS). In the project THESEUS-TEXO, the Visual Semantic Analysis Framework (Sophie) was developed by Fraunhofer IGD. It combines visualization, ontology-learning and modelling techniques to support Semi-automatic modelling of services. It allows service providers to extract semantic information from structured and unstructured data e.g. service descriptions and service ontologies. The extracted semantic information supports service providers to model their new services.

An important element that has to be considered is that some SIMPLI-CITY partners have also been partners in SOA4All and TEXO projects. This could bring positive experience into SIMPLI-CITY and therefore the possibility to build upon their project results.

3.2.2 Markets and Actors for End Users' Apps

The end user apps belong to the second main outputs group of the SIMPLI-CITY project. End users' apps are strictly connected to the PMA, the voice-based and multimodal user interface, which will make the safer and unobtrusive control of all mobility-related services easy to accomplish. Aspects related to market are very relevant to the end user apps, being apps often provided under paid subscription. But attention has to be paid also on other actors, because many of them are in a more advanced stage of development and diffusion among users.

Another important consideration must be done: systems similar to the SIMPLI-CITY PMA could be based on mobile applications or could be themselves embedded car applications, then both fields will be analysed. In this chapter these two fields will be kept separated in order to facilitate highlighting of different subjects.

3.2.2.1 Mobile Applications Markets

Some services provided by SIMPLI-CITY could work under paid subscription. A first list of such services can include:

- Real time traffic information.
- Real time vehicle performance information.

- Extended route planning (where the users can specify which sights they are interested to see on their way) and guided tours.
- Premium bitrate/content radio stations streaming.
- Live chat with other participants (like CB radio used by truck drivers).

Buyers of such services could be:

- Private individuals.
- Organizations equipping their vehicles with an extended set of SIMPLI-CITY applications (like tour buses).
- Taxi companies wishing to entertain/inform their customers.
- Local Bodies/Authorities sponsoring (or indirectly sponsoring via financial means like tax breaks) usage of eco-friendly applications to be used for free by individuals.
- Third party organizations trying to promote their services and developing free Apps.

3.2.2.2 Mobile Applications Actors: Private Companies

Competition in the field of mobile applications is a very complex and open scenario as the market is constantly evolving, thanks both to private companies and to the results of many projects funded by the European Commission in this field. However, SIMPLI-CITY will be able to provide end users with an innovative full set of features and interfaces, that, in some cases, combines many of the successful aspects of the current apps.

The first valuable example is Siri, Apple's voice controlled personal information agent. The app can manage many features of iPhone, for instance using the telephone, playing music, Facebook updating, navigating with Apple's built-in maps etc. It also contains a general question-answering capability, using the Wolfram search engine. It also promotes position-based searches, like locating the nearest ATM, café, etc. Among Siri advantages, there are its really good coverage (grammar as well as tasks), a reasonably good feedback model, and its availability to many iPhone users. Among its disadvantages, there are the availability only for iOS, the relatively rudimentary dialogue engine and the closed APIs (only Apple decides what should be voice controlled).

Analogously to Siri, Google launched Google Now as an intelligent personal assistant available for Google's Android operating system. Google Now uses a natural language user interface to answer questions, make recommendations, and perform actions by delegating requests to a set of web services.

A third example, more social and traffic oriented, is represented by Waze: a navigation and traffic information application with community-crowd sourced road map data, traffic flow information, traffic alerts etc. It also has support for posting destination information on Facebook (including ETA) and social gaming features. Waze has also included support for locating gas stations based on price. Waze has a very rudimentary, command based, voice control, and has voice output for its turn-by-turn navigation. Waze is a smartphone app, with more than 29 million users and it is free of charge for the end users. The business model relies on income from advertising in different forms.

One of the most important hybrid systems (both mobile and automotive) in the mobile market is Automatic, a smart driving assistant marketed since 2013 in the U.S. by Automatic Labs, Inc.. Automatic works through a small device that connects car's on-board computer and users' smartphones in order to combine data and to provide a series of services to the driver. The Automatic Link plugs into the On Board Diagnostic (OBD) port, usually used for maintenance reasons by mechanics. At the moment, Automatic only

supports drivers living in the U.S. but it is planned to be spread to other countries in the future.

3.2.2.3 Mobile Applications Actors: European Funded Projects

Assessing the results of EU funded projects, a similar player as SIMPLI-CITY is SMART-WAY (www.smart-way.mobi/), an FP7 funded project aiming to develop a real public transport navigation system based on mobile devices that gives passengers the possibility to act as they are used to do with common navigation systems in their cars. Once entered the destination of their trip they will be able to get into a vehicle and to jump off/on as often as they like to. The system will always guide them to the destination. Passengers are no longer bound to a printout of the route. They may change and interrupt their trips as often as they want to.

Analogously, the project Smart-ip, funded by the EU CIP Programme, took charge of the Web-based user interface (http://smart.comune.bologna.it/mimuovosmart/) that allows to access services, identified and provided by the two local partners (Municipality of Bologna and Emilia Romagna Region), and its usability through mobile devices. The enhancement of the Bologna Smart Mobility system includes the setting up of a multichannel Internet service for citizens and officers providing information updated in real time on mobility in the city. The service interfaces as regard the data publishing is co-designed involving citizens to be compliant with “user experience” techniques.

Another EU funded experience is given by Co-Cities (http://co-cities.eu/) that is a pilot project to introduce and validate cooperative mobility services in cities and urban areas. It will develop a dynamic 'feedback loop' from mobile users and travellers to the cities' traffic management centres, and add elements of cooperative mobility to traffic information services. These software extensions are based on the In-Time Commonly Agreed Interface (CAI), and the pilots will be run in the cities of Bilbao, Florence, Munich, Prague, Reading, and Vienna.

3.2.2.4 Car Embedded Applications Market

During the last decade, a number of automotive manufacturers have started to introduce on the market a number of solutions to offer the driver a joint information and entertainment system, the so called infotainment system.

Recent examples of automotive infotainment solutions are BMW ConnectedDrive, Daimler COMAND, Volkswagen Car-Net, Audi Connect, FIAT Blue&Me, FIAT Chrysler UConnect, Toyota Entune, FORD SYNC, Chevrolet MyLink, Renault R-Link, Saab IQon.

A number of the existing infotainment platforms extend the traditional navigation systems with Internet-based, value-added services such as real-time traffic or dynamic speed limit information. In addition to that, Apps are offered to the driver e.g. to use certified iPhone apps within the car, or to update the current Facebook status or retrieve Twitter news on the infotainment system. Newly offered apps include also online-routing, weather-forecast service, gas price, travel information or news, and added value customer services like for example parking or restaurant reservation.

It shall be noticed that a number of the app-based infotainment platforms are proprietary and therefore third parties cannot offer additional apps. At the same time there are also examples of infotainment platforms that do not follow an app-based approach but are also not extendable by third party as they operate with pre-installed software services.

Some of the infotainment platforms are connected to car sensors and provide up-to-date information about the current condition of the vehicle; they may also enable drivers to upgrade the system with additional new functionalities making use of the in-car software-functionality.

Another example of an infotainment system is extending the navigation system with the ability to access information about the vehicle conditions.

Functionalities such as hands-free calling, which can be activated by speech, eco drive functions, searching via text or speech to look for Points of Interests (POIs), the possibility for drivers to connect their smartphone to remotely operate on a number of vehicle functions such as climate control and a vehicle finder are also available in various infotainment systems.

Infotainment platforms that can make use of apps installed on the driver's smartphone, e.g., to play driver's favourite music, or to interact with social networks such as Twitter or Facebook are also available.

However, it shall be mentioned that different in-car infotainment systems provide their own app-stores, like Ford AppLink or Renault R-Link systems, in which third party developers can provide their own apps, that obviously require an approval for safety, security and malware issues.

Besides the automotive manufacturers, independent companies are providing their own infotainment system either alone or in cooperation with an automotive manufacturer. For example, Navigon and TomTom work closely together with big automotive manufacturers as well as SatNav. Tizen, the successor of MeeGo, is a Linux-based software platform for multiple devices, including in-vehicle infotainment systems. The latter has been named Tizen IVI and is supported by the Automotive Grade Linux project, which is part of the Linux foundation. The Automotive Grade Linux project is supported by several companies like Intel, Samsung, etc. In addition to that, Automatic, a smartphone app, has been launched recently (as already mentioned in Section 3.2.2.2); it connects a car on-board computer with the driver's smartphone and monitors the user's driving style providing audio feedback in order to improve it; an automatic crash detection to report an accident automatically to the police is also included.

The SIMPLI-CITY project performed an overview analysis, based on public data, of the different infotainment systems in order to understand:

- System openness, i.e. if it is proprietary or open.
- System extendibility, i.e. if additional apps can be installed or if an App marketplace is available.
- The eventual availability of an open API, so that developers can add their own applications.
- The cases in which a "3rd Party" is supported, although an open API is not available, but developer may add their own apps.
- The availability of a "Smartphone Remote App"-feature, meaning that the car or the infotainment system can be controlled remotely.

Since almost every system provides the ability of making calls or texting, the ability of using smartphone apps via the infotainment system is considered as available.
The analysis, held in March 2013 on 15 different infotainment platforms, on a brand independent way, led to the following outcomes:

Table 3: Overview of the Main Features Related to Automotive Infotainment Systems

Operating System	Extendable	API / 3rd Party	Smartphone Remote App	Smartphone Apps (Beside of calling, texting)	Comments
12 Proprietary	8 not extendable	12 No/No	10 No	11 No	4 infotainment platforms enable only “specific” certified apps
2 Android-based, but modified (“normal” Android apps cannot be used)	7 extendable (either app based or not)	2 Yes/Yes	4 Yes	4 Yes	
1 Linux; can run Android apps through standard layer		1 No/Yes	1 unknown		

Starting from this overview analysis, SIMPLI-CITY can now really move on with its design and functional architecture phases, being able to take into account how the SIMPLI-CITY services can be best interlaced with the actual market technical offers of the automotive infotainment platforms. The unique automotive selling point of the SIMPLI-CITY system and Personal Digital Assistant (PDA) will consequently be the possibility to link mobility based services to the highest possible number of different infotelematic solutions.

3.2.2.5 Automotive Market

The first picture presented in this section (Figure 9) shows the key figures of the automotive market in Europe and indicates the relevance the automotive market has in Europe in terms of competitiveness and GDP. The second one (Figure 10) indicates that around 10% of the European employment is related to automotive. The third (Figure 11) indicates the Motor vehicle production in Europe by country. All these pictures are reported here as a reference to give the dimension and the importance of the automotive market in Europe.

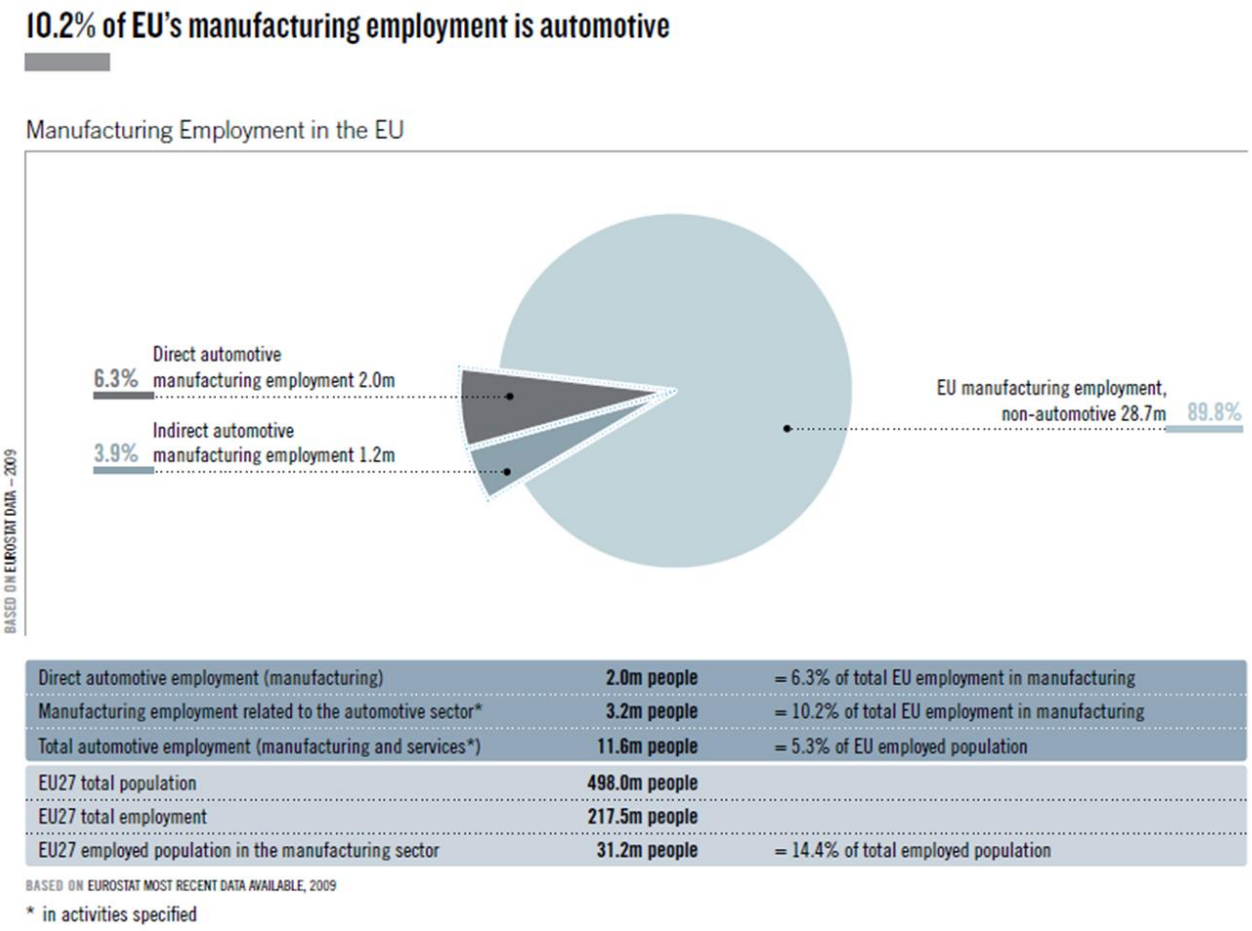
Key figures

PRODUCTION	Total Motor Vehicles (Worldwide)	2011	80.1m units	
	Total Motor Vehicles (EU27)	2011	17.7m units	= 22% of worldwide MV production
	Total Passenger Cars (Worldwide)	2011	59.9m units	
	Total Passenger Cars (EU27)	2011	15.7m units	= 26% of worldwide PC production
	Production value	2009	€522 bn	
NEW REGISTRATIONS	Total MV (Worldwide)	2011	78.5m units	
	Total MV (EU27)	2011	15.1m units	= 19% of worldwide MV registrations/sales
	Total Passenger Cars (Worldwide)	2011	65.4m units	
	Total Passenger Cars (EU27)	2011	13.1m units	= 20% of worldwide PC registrations/sales
	Diesel (Western Europe)	2011	56 %	
EMPLOYMENT	Manufacture of Motor Vehicles (EU27)	2010	2.0m people	= 6% of EU manufacturing
	Total (including indirect, EU27)	2009	11.6m people	= 5% of EU employed population
TURNOVER	Manufacture of Motor Vehicles (EU27)	2009	€625.0 bn	
R&D INVESTMENT	ACEA members	2009	€26.0 bn	=5% of turnover
VALUE ADDED	EU27	2009	€99.0 bn	= 7% of manufacturing sector
EXPORTS	Extra-EU27	2011	€104.0 bn	
IMPORTS	Extra-EU27	2011	€28.7 bn	
TRADE BALANCE		2011	€75.3 bn	
MV IN USE (PARC)	Total Motor Vehicles	2010	273.7m units	
(EU27)	Passenger Cars	2010	238.8m units	
	Motorisation rate (cars)	2010	477 per 1,000 inhab.	
TAX REVENUE FROM MOTOR VEHICLES (EU15)		2011	€375.1 bn	= 3.3% of EU15 GDP

W.EUROPE = EU15 + EFTA

SOURCE: ACEA, VDA, AAA, IHS GLOBAL INSIGHT, EUROSTAT

Figure 9: Key Figures of the European Automotive Market [ACE12]

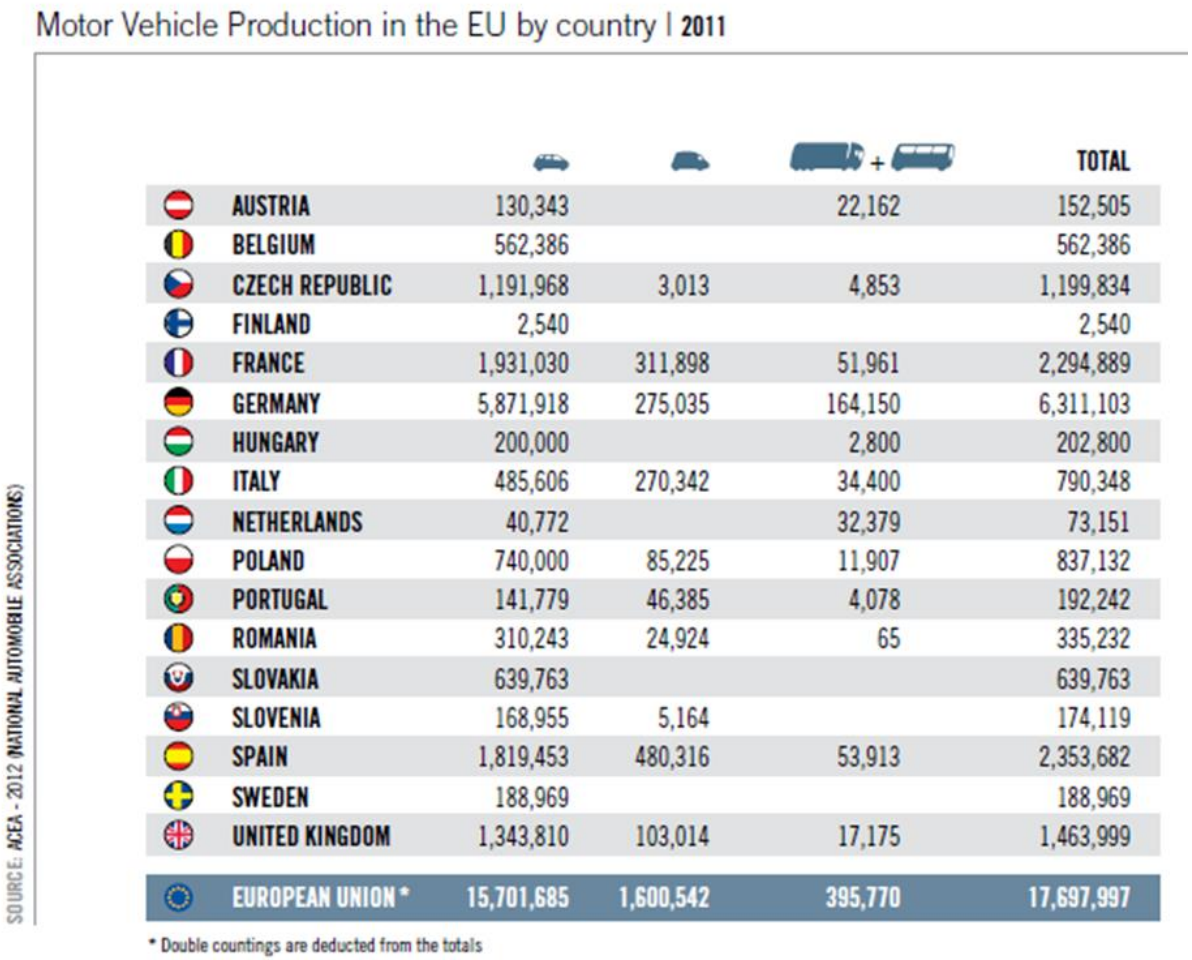


Direct automotive employment (manufacturing)	**2.0m people**	= 6.3% of total EU employment in manufacturing
Manufacturing employment related to the automotive sector*	**3.2m people**	= 10.2% of total EU employment in manufacturing
Total automotive employment (manufacturing and services*)	**11.6m people**	= 5.3% of EU employed population
EU27 total population	**498.0m people**	
EU27 total employment	**217.5m people**	
EU27 employed population in the manufacturing sector	**31.2m people**	= 14.4% of total employed population

BASED ON EUROSTAT MOST RECENT DATA AVAILABLE, 2009

* in activities specified

Figure 10: European Automotive Market Manufacturing Employment [ACE12]



Motor Vehicle Production in the EU by country | 2011

			+	TOTAL
AUSTRIA	130,343		22,162	152,505
BELGIUM	562,386			562,386
CZECH REPUBLIC	1,191,968	3,013	4,853	1,199,834
FINLAND	2,540			2,540
FRANCE	1,931,030	311,898	51,961	2,294,889
GERMANY	5,871,918	275,035	164,150	6,311,103
HUNGARY	200,000		2,800	202,800
ITALY	485,606	270,342	34,400	790,348
NETHERLANDS	40,772		32,379	73,151
POLAND	740,000	85,225	11,907	837,132
PORTUGAL	141,779	46,385	4,078	192,242
ROMANIA	310,243	24,924	65	335,232
SLOVAKIA	639,763			639,763
SLOVENIA	168,955	5,164		174,119
SPAIN	1,819,453	480,316	53,913	2,353,682
SWEDEN	188,969			188,969
UNITED KINGDOM	1,343,810	103,014	17,175	1,463,999
EUROPEAN UNION *	15,701,685	1,600,542	395,770	17,697,997

* Double countings are deducted from the totals

SOURCE: ACEA - 2012 (NATIONAL AUTOMOBILE ASSOCIATIONS)

Figure 11: Motor Vehicle Production in Europe by Country [ACE12]

In this landscape, the SIMPLI-CITY project outcomes, namely the mobility services that can be offered in the Original Equipment Manufacturers (OEMs) infotelematic systems (in combination with the PDA) can accelerate the market deployment of all functions that are related to the so called connected mobility.

Today, the connected mobility, or cooperative mobility network, needs market accelerators to speed up market deployment of a number of very important functions for safe, efficient, and green mobility: in 2015, the eCall implementation is expected to be mandatory in all new vehicles, so at least 4G-LTE communication will be available on cars. However, this is not enough as in the last decade OEMs, automotive and technology suppliers, road operators, service providers, research institutes all over Europe had been working together to create the technological building blocks of the cooperative mobility network.

Why this joint activities? Because the number of road accidents in Europe is still very high, and roads and cities are more and more congested resulting in a reduced quality of life for all citizens and in a polluted environment.

European citizens are still losing their lives or are seriously injured in road accidents and the number of hours spent in traffic jams is increasing every year.

The cooperative mobility network should be implemented to enable applications to prevent road accidents for all road users (cars, trucks, motorbikes, pedestrians, cyclists) and to

improve traffic efficiency, with a consequent reduction of CO_2 emissions. Additional customised services for the users (like the SIMPLI-CITY ones) should also be made available to enable a sustainable deployment.

However, to create the mobility network all stakeholders should now:

- Move together from technological prototypes that are proving the feasibility to robust components for vehicle and infrastructure communication.
- Create interoperable and standardised solutions at European level.
- Design a sustainable deployment roadmap that is affordable for all stakeholders involved.
- Create a high level of acceptance in the wide public.

In conclusion, the deployment of the services that will be offered by the SIMPLI-CITY project outcomes will represent an important piece of the puzzle of the so-called European Wide Service Platform. They will have a huge market potential (depending on the interoperability with the different solutions of infotainment systems) and they will add one accelerating factor to the deployment of the cooperative mobility network that will connect all vehicles, road and city actors.

4 Use Cases

In this chapter, the SIMPLI-CITY use cases are examined, with the aim to highlight which potential markets are affected by the use cases.

The analysis here is limited only to the use cases approach, while a wider vision of potential target market is given in Section 5 where the SIMPLI-CITY strategy is drafted.

4.1 Personalised Traffic Restrictions

The first scenario focuses on providing road users with applications that will help to simplify and optimize their driving in urban areas with specific traffic restrictions.

This scenario is based on the real case of Bologna, where the urban area is divided into some sub-areas with different traffic restrictions, depending on the weekday and on the daytime. Some examples: the historic city centre is almost completely a Limited Traffic Area (LTA), where access is allowed only to residents and authorized vehicles. But during Saturdays, Sundays, and public holidays the circulation in part of this area is further restricted and allowed only to pedestrians and cyclists (the so called T-DAYS event). Another example is given in the area close to the Stadium, where traffic rules are affected by deviations during football and other events, and only residents can access and drive through it. The above mentioned restrictions affect also the public transport networks, and some bus stops become inactive.

The main target markets addressed by the Bologna scenario could be divided into four categories: public authorities, Internet service providers, location-based services providers, and road users.

4.1.1 Public Authorities

Public bodies and authorities, which supply data and provide citizens information and services, are directly addressed by the market of SIMPLI-CITY. They can make use of the SIMPLI-CITY platform in order to optimize and improve transport and mobility in cities through route optimization and multimodal choice options suggested to road users.

Optimization of traffic as well as multimodal increase (towards sustainable means of transport), will produce good results and positive consequences for Local Bodies/Authorities leading to an improvement of air quality level and to a reduction of traffic congestion that directly affect the quality of life in the city.

At the same time SIMPLI-CITY will offer the possibility to include a wide range of other data (information about public services) that could be directly queried by road users (citizens or visitors) or by other apps. This information is mainly related to tourism, real time traffic, public transport (for a more detailed analysis see Section 4.2.1).

4.1.2 Internet Services

In addition to integrating data coming from many sources and offering them as applications, SIMPLI-CITY will provide a platform where Internet services could access to offer to users further conveniences, in this use case specifically related to the access in predefined area.

The only kind of companies that can make use of these kinds of services includes:

- *Maps and navigation systems providers*: these companies provide geo-referenced maps with information about different places and hotspots of the city or the road, and turn-by-turn navigation systems.

4.1.3 Location-based Services

The personalised traffic restrictions use case, being closely related to a specific geographical area, is particularly suitable to those services that are offered in that area.

Different kind of businesses can benefit from these services, such as:

- *Retailers, restaurants and hotels*, *theatres, etc.* that can provide information about locations, special offers, availability and opening hours.
- *Touristic services providers* that can integrate touristic information (audio-guided site visits, historical information, etc.).

4.1.4 Road Users

Road users are a kind of horizontal final target of SIMPLI-CITY dealing directly with traffic restrictions and periodic pedestrianizations.

As a consequence, road users have to face a highly dynamic scenario, since the traffic regulation changes significantly during the weekend and the access to predefined areas depends on personal status, permits and vehicle used.

In this scenario, the SIMPLI-CITY project will help road users through a Personalized City Access Service, to reach their destination avoiding forbidden areas, optimizing the routes, and suggesting any possible multimodal solution.

The Personalized City Access Service will cross-evaluate mobility-related data (traffic restrictions but also congestion level, road works, etc.) and specific authorization of any single road user. This will allow to create personalized routes based on user status and real time data.

In addition, with traffic restriction control, the Personalized City Access Service will suggest road users also other possible means of transport, for example a combination of bus and walking or cycling to reach the very central and restricted area. In order to motivate road users towards eco-friendly vehicles (such as public transport and bicycles) SIMPLI-CITY will highlight an estimation of the cost of the trip and the CO_2 emission, which depends once again on any single road user and his vehicle.

4.2 Enhancing the Driver Experience

This scenario focuses on providing to road users applications and services that will help to improve their driving and travelling experience. The scenario shows some examples of applications and services that make use of media streams, open data repositories, or link to social networks. But these are just a small subset of potential applications and services that could be provided to the passengers of the vehicle.

This section covers the market sector of different businesses that can take advantage of the SIMPLI-CITY platform to provide different kinds of services to road users in order to enhance their driving experience.

Three main sectors have been identified: public government services, Internet services, and location-based services.

4.2.1 Public Government Services

Public government aims at providing the best services to citizens, and makes use of information technologies to improve the efficiency and effectiveness of service delivery in the public sector.

As already mentioned in Section 4.1, civic authorities can make use of the SIMPLI-CITY platform in order to optimize and improve transport and mobility in cities.

Another main use of information technologies by the government is to provide information to citizens. Among others, information about public spaces can be of great use for road users. Some examples may include:

- *Tourist sites and attractions*: travellers may find useful the information of the main touristic Points of Interest of a city or close to their route while in a journey.
- *Traffic*: information about real-time traffic allows the road user to take the best route to a destination.
- *Accident hotspots*: this information makes the drivers aware of dangerous spots and thus permits to improve their security.
- *Public transport schedules and geographic information*: drivers may need to use public transport instead of the car, for example in case of congestion. So information about stops, routes and real-time schedules of different public transport can permit to find alternative routes to a destination.

4.2.2 Internet Services

Several service providers can leverage the SIMPLI-CITY platform in order to provide Internet services applications to passengers of a vehicle, mainly related with entertainment and information (Infotainment), but also providing other benefits like navigation or productivity.

Some of the companies that can make use of this kind of services include:

- *Maps and navigation systems providers*: these companies provide geo-referenced maps with information about different places and hotspots of the city or the road, and turn-by-turn navigation systems.
- *Radio stations*: they provide radio broadcast via streaming media on the Internet.
- *Multimedia providers*: different kind of multimedia like movies or music can be provided via audio and video streaming, or it can be downloaded and reproduced afterwards in an offline mode.
- *Content providers*: content providers create and provide information like news, blog posts, or weather forecast.
- *Social networks:* they can provide applications to road users that permit to connect to social networks and share information like their location or status updates.
- *Communication services*: this group includes email, voice, or messaging services.

4.2.3 Location-based Services

The location of road users enable services to make use of this information to provide tailored services depending on the surrounding environment of the users, e.g. services by proximity.

Different kind of businesses can take benefit of these services:

- *Fuel companies:* they can make usage of proximity information to incentive drivers to use their Filling Stations by means of offers or loyalty programs.
- *Restaurants and hotels:* if the driver is in a journey and needs to find a restaurant or hotel, the platform can permit to search for them and to receive discounts based on location.
- *Retail:* similar to the restaurant and hotels case, the user may need to find a retail store, so these companies can provide information about their stores and incentive drivers to stop and buy.

4.3 Road Traffic Diagnosis and Prediction

This scenario focuses on providing to road users applications and services that will help to improve their driving and travelling experience. The scenario shows some examples of applications and services that make use of media streams, open data repositories, or link to social networks. But these are just a small subset of potential applications and services that could be provided to the driver and passengers of the vehicle. Contrary to Section 4.1 and 4.2, in 4.3 the benefits of the applications are exposed in a SIMPLI-CITY context, as traffic diagnosis and prediction are quite new research challenges in transportation domains. In both detailed scenarios, the main beneficiaries are cities, their transportation department, car drivers, and more generally citizens.

4.3.1 Road Traffic Diagnosis

Every year road traffic congestion wastes billions of hours of time and produces tons of carbon in the atmosphere [AS94]. More important, it is getting worse, year-by-year. It also used to (i) stress and frustrate motorists, encouraging road rage and reduce health of motorists [LPS99], and more dramatically (ii) interfere with the passage of emergency vehicles traveling to their destinations where they are urgently needed. All of them, among others, are examples of negative effects of congestion in cities.

Traffic congestion can be easily detected, visualized and analysed [BBF+10] through stream traffic data (e.g., GPS location of vehicles, loop detector). Optimization mechanisms using existing data mining [LTW+05] and machine learning approaches [BW01] are examples of techniques used by modern traffic systems. However the problem of explaining congestion causes is a more complex challenge. About half of traffic congestion is recurring, and is attributed to rush hours; most of the rest is attributed to road accidents, road works, major events or weather conditions. However obtaining explanations in real-time when a congestion suddenly occurs in the road network is yet an unexplored problem in transportation research.

This scenario addresses this diagnosis problem i.e., how to identify the nature and cause of congestion? How do large events such as a concert impact traffic conditions? Shall we expect delays? Is re-routing appropriate? Such question remains open because (i) relevant data sets (e.g., road works, city events), (ii) their correlation (e.g., road works and city events connected to the same city area) and (iii) historical traffic conditions (e.g., road works and congestion in Canal street on July 24th, 2010) are not fully open and jointly exploited. Pure Artificial Intelligence (AI) diagnosis approaches [SPT07] focus on point (iii) for inferring the cause-effect relationships while semantic web technologies [BHL01] tackle points (i) and (ii) for integrating heterogeneous and large data. However, pure AI diagnosis

approaches fail to timely compute diagnosis results for large-scale applications such as the traffic one. This work will extend the scope of pure AI diagnosis approaches to compute accurate diagnoses for situations where cause-effect relationships have not been established before. The list of potential heterogeneous sources of effects (road traffic congestion) and their causes (e.g., road weather conditions, events) considered in this scenario will be provided within city partners of the consortium i.e., Dublin City (through dublinked.ie agreement) and Bologna.

Using the context of SIMPLI-CITY, various sources of data from the transportation department of large cities (first Dublin, Bologna) will be used to decrypt the reason of congestion in such cities. The automated diagnosis method, core reasoning service of SIMPLI-CITY, will be used for helping the car driver to have understanding of real-time traffic situation in cities.

Semantic web technologies for integrating heterogeneous data (WP4) will be applied, then enabling advanced analytics, exposed as services in WP5. Our approach will automatically (i) detect real-time congestions as traffic anomalies and (ii) retrieve their diagnosis as the set of possible events that could be the causes. In a traffic context, queries such as ”Why is there a traffic congestion in Dawson road now?” are answered by our approach: ”This is caused by a music concert in Canal road that starts in 30 minutes, with a probability of 0.4”.

4.3.2 Road Traffic Prediction

Good road navigation systems should be able to anticipate critical situations in road traffic e.g., congestion, major delays, strong perturbations, so relevant and accurate solutions are available in real-time. SIMPLI-CITY, through this scenario and its exposed service, aims to provide such a navigation system. In particular the spatial-temporal correlation of heterogeneous data will be used in WP4 for anticipating a critical situation in road traffic and then provide flexible services to car drivers. All high-level services from SIMPLI-CITY would be able to make use of this service.

4.4 Enhancing Driver’s Ecodriving Experience

SIMPLI-CITY will enhance the driver’s ecodriving experience in order to achieve the optimal balance among a number of factors, like for example: eco-friendliness (saving unnecessary fuel), estimated travel time, estimated time to arrival to each destination (and related probability), other specific features (e.g., related to the target destination or the recommended time to reach a destination).

Similarly to the previous Section 4.3, this one covers the market sector of different businesses that can take advantage of the SIMPLI-CITY platform to provide different kind of services to road users in order to enhance their Eco-driving experience.

Two main sectors have been identified: automotive market and public authorities. The market context of eco driving functions is the automotive market, therefore a direct impact of the deployment of the SIMPLI-CITY solutions that are planned in this use case will affect the automotive market and its business value chain.

However an indirect impact can also be foreseen with the involvement of public authorities in the smart cities of the future: the availability of data related to optimised fuel consumption and consequent reduction of CO_2 emission can offer city public authorities the possibility to create new incentives or to plan in advance what to do in critical situations

(e.g., when the combination of adverse weather conditions and city pollutions is forcing cities to close the city roads to private vehicles).

Ecodriving can reduce CO_2 emissions by helping people to use less fuel. But how significant is this reduction, and how easy is to achieve it, can be obtained studying thousands of journeys made by drivers using SIMPLI-CITY, which helps people monitoring their fuel efficiency and learning eco-driving techniques.

The responsibility of the car manufacturers towards the environment doesn't stop at technological advances that reduce CO_2 emission of its vehicle. For a long time this area has been the focus of the car industry in its response to the challenges of climate change and thus rightly it concentrated on the responsibility towards the innovation to produce low emission cars. Technological innovations are essential in the move towards reducing emissions from driving.

Whilst technological innovations are essential in the move towards reducing emissions from driving, the strength of ecodriving is that it is accessible and universal; it is something that can be applied by any individual in any vehicle at any time helping to bring down the emissions from driving immediately. Ecodriving only requires drivers to understand and adopt driving techniques and there is no cost and no equipment. This means that ecodriving can have a universal and immediate effect..

Any vehicle can be driven with ecodriving techniques. From the most polluting vehicle to the newest hybrid to an electric car. Ecodriving provides a way to reduce energy consumption, which is important regardless of the fuel or its emissions factor.

For the individual driver, ecodriving is often free but driving techniques have to be learnt. Learning the techniques is part of the driver experience and can be realized through freely available "eco-tips", through government-supported eco-training courses, or through on board devices like dedicated OEM ecodriving assistants or gear shift indicators. All these techniques can benefit from the SIMPLI-CITY apps and PMA. The SIMPLY-CITY approach will also permit to make analysis related to eco-driving based on real journeys made on real roads, by real drivers going about their everyday lives. The integration of such amount of data will make possible for drivers to easily learn an ecodriving style, with eco-driving strategies based not only on vehicle data but also on external factors. This will have a deep influence on drivers efficiency and potential savings.

The analysis that SIMPLI-CITY can perform on eco-driving can be based on real journeys made on real roads, by real drivers going about their everyday lives. Drivers can learn easily to have an ecodriving style, basing also on external factors influencing their efficiency and the potential savings.

Understanding more about the value of ecodriving as an approach, and the challenges that it faces, helps to clarify the scenario that SIMPLI-CITY will include. In order to enhance the ecodriving experience SIMPLI-CITY will focus on the following main features:

- Comparison of different routes.
- Optimisation of eco driving and fuel consumption of a journey.
- Vehicle Information on the Web for eco driving style comparison.
- Eco-efficiency contest.

SIMPLI-CITY will help the drivers to plan and perform tasks scheduled for the day considering which are the ones that have a fixed time schedule but at the same time suggesting to perform a specific tasks at a certain time due to the traffic flows in that area

and avoiding to perform tasks because nearby there is a special event and all the streets are closed to traffic in that particular area. SIMPLI-CITY will also allow to compare (eco-) efficiency of different routes by combining the available real-time information about routes, information about the driver's average driving style, the vehicle topology, etc. Data may also be obtained from cooperative systems, telematics, mobility-related smart objects, and open (government) data repositories on the Web.

Information about user's driving style and vehicle characteristics will be taken from and calculated by the car, respectively. The best eco-aware route solution will then be proposed to the user.

In order to reduce the carbon footprint and the fuel consumption, SIMPLI-CITY will inform the user about its driving style performance with regard to acceleration, braking, gear changing, etc. An according app making use of this information will be able to provide it with suggestions on how to improve its performance and how to save fuel for that particular recurrent journey. The SIMPLI-CITY PMA will also be able to provide live feedback about user's driving style through an according app and will suggest to decrease the vehicle speed in order to reduce the current CO_2 emission.

SIMPLI-CITY allows the user to access journey-related data using Web browser and the verification if it follows an eco-driving style or not. It can check how to improve the duration of the trip and how it can save money by reducing the fuel consumption. Furthermore, it is able to access a driver's log on the car's Website.

The user's ability will be represented with some leaf icons on the Website. For instance, the user will receive 4 leaves out of 5 possible leaves for his acceleration behaviour if she/he is following a near-optimal driving style. Similar evaluations will be given for other eco-driving performance metrics like braking and gear changing; an overall assessment will also be given.

The driver is part of a community that shares its eco-driving information through a SIMPLI-CITY enabled app in order to compare the individual performances. This way, it is possible to compare the individual (eco-)performance against the performances of other drivers with comparable parameters, e.g., similar traffic situation, similar cars, and of course similar journeys.

An Ecodriving Contest will compare drivers using similar vehicles on similar routes and awards the "winners" on a regular basis. The best performing drivers will earn rewards from the SIMPLI-CITY system, e.g., by "liking" or giving "+1" to their driving performance in social networks like Facebook or GooglePlus. This further improves the motivation of the drivers to act environmentally aware by publicly announcing good results.

An Ecodriving Contest could also be hosted by municipalities or similar governmental agencies in order to award eco-friendly driving behaviour: in such a scenario, the driver would receive some award points from a municipality which can be converted into a discount on next parking ticket or free ticket for the bus.

5 SIMPLI-CITY Strategy

5.1 Business Orientation

As mentioned in the SIMPLI-CITY deliverable D2.1 Project Vision Consensus, the main aim of the SIMPLI-CITY project is to "*facilitate business innovation on three different levels – the development of end user apps, contributions to the Internet of Services, and the exploitation of mobility-related data sources*". Thus, SIMPLI-CITY will focus its developments in solving business/users oriented problems rather than develop apps and services without any clear background. This will enable its future exploitation, since the results obtained will be based on providing software layers in the rather hardware-driven mobility sector. Taking the example of the different use cases outlined in previous sections, the project will stimulate the development of exclusive value-adding services around mobility and transport, which ultimately could lead to completely new markets in the mobility domain.

Whilst the focus of SIMPLI-CITY is aimed at the final user driving experience market, the resulting applications and services should be applicable (i) for the developers' community since they provide more and more applications and services which might be based on the ones developed during the project; (ii) for the car manufacturers working at improving the infotainment devices installed in the cars; (iii) for the local/regional/national public administration, since they provide services pulling information in the system to be used by the applications and services. The case companies are divided into manufacturing and public administration sectors, but the issues faced in the manufacturing one are comparable to other sectors too. SIMPLI-CITY aims are to enhance and facilitate the consumption of information and the driving experience by improving the data publishing and the interoperability between processes and IT systems.

SIMPLI-CITY aims at applying concepts of Service-oriented Architectures (SOA) to enhance and achieve interoperability and data integration at a deep technical level as well as concepts of Cloud Storage to publish meaningful information for the driver. The SIMPLI-CITY model makes use of mobile communication channels to retrieve the information from the sources (sensors, public bodies, etc.) and send that information in a structured way in the moment and in the place the user needs it. As an example, the City of Bologna has wide experience in collecting data about mobility that could provide drivers and pedestrians with information about their needs when driving or connecting to sources of information. Generally speaking, city operators may make use of the SIMPLI-CITY framework by providing easy-to-access mobility data relevant to their cities. The other case companies are also willing to improve their products and services to offer their customers, the drivers, with a full range of value added services. So, SIMPLI-CITY could be viewed as one of the platforms managing mobility-related city data from heterogeneous domains in a dynamic way. This could spark interest from service suppliers and data providers.

The enhancement of the driving experience concept allows the information providers and the information consumers to act as a closely coupled larger entity. SIMPLI-CITY is looking to fulfil this lack of direct communication. Cloud storage and Mobile Apps/Service computing solutions should help to overcome this aspect by reducing the cost of

developing new apps/services and the ones implemented by SIMPLI-CITY should offer greater connectivity, flexibility and interoperability.

As a conclusion, the establishment of new markets for the envisioned mobility services and end user apps offers new possibilities to small and medium software vendors, meaning that the Service and Application Marketplaces will lead to low market entry barriers.

5.2 What Can SIMPLI-CITY Do for the Market Sector?

As said in the introduction of Section 3.1, SIMPLI-CITY is a complex project aiming to deliver a Mobility Service Framework and a Personal Mobility Assistant (PMA), by following the Mobility-related Data as a Service approach.

SIMPLI-CITY users can be divided in two groups: (i) the information consumers, mainly car drivers, bus users, cyclists and pedestrians, who have the possibility to get more knowledge when planning routes and (ii) the information publishers, public administrations and other organizations, who have the possibility to provide the information for all the users independently of their location, language and other factors. To meet these users' needs, SIMPLI-CITY will provide apps and services to be executed in mobiles, GPS or infotainment devices with which the users conduct semantic searches looking for new apps or receive suggestions of apps based on their history and user profile. In other words, transfer the concept of mobile apps to the automotive sector.

For instance, in order to enhance the driving experience as shown in the scenario outlined in Section 4.2, SIMPLI-CITY will provide apps and services fully dedicated to cover the needs of the driver while preventing distractions. In addition to these apps and services, which create the basis for enhancing the driving experience, a set of services for providing information about traffic lights or restricted areas is of valuable use not only for the drivers but also for the pedestrians or bike users. This kind of information will be accessible through the services provided by SIMPLI-CITY pulling the data from the information publishers' data sources and storing them in the Cloud repositories for consumption by the users. With this information in the users' devices, they can choose better routes, avoid problems or simply change their decision on riding their bicycle instead of driving the car.

At the same time, the number of drivers who are interested in an eco-sustainable mobility is growing every day. A specific SIMPLI-CITY scenario will provide a number of services and end user apps that SIMPLI-CITY will offer in order to enhance the driver's eco-driving experience.

The other target market of the SIMPLI-CITY project is the developer's community. As already stated in D2.1, SIMPLI-CITY aims at creating a Services and Apps Marketplace tailored to the developers to sell their own services and/or apps. To develop these services and apps, the project will also develop the so-called SIMPLI-CITY Studio with which these services and/or apps could be created easily. By providing this Studio (as an open and unified environment), SIMPLI-CITY will decrease the market entry barriers for new players in this community. This Studio will be quite similar to SOTA Development Suites but with the particular SIMPLI-CITY API which will allow access to heterogeneous data sources, easing the integration of the information stored in them and the pre-fetching of the data. These data sources might be based upon open (government data) or any other kind of third party provider. As a consequence of the engage of the developer's community and the provision of the SIMPLI-CITY Studio, the project is able to provide a range of

innovative approaches for achieving environmental friendliness of mobility and transport by alleviating the development of according services and apps.

5.3 Future Business by Adapting SIMPLI-CITY

SIMPLI-CITY affects future business and life style in multiple and positive ways; as already mentioned developers are provided with a set of services for developing future apps and services for the benefit of the end user no matter which role he/she plays on the road. Other services such as tagging or feedback from social networks might be used to improve the driving experience with real time information. Further, by getting updated information like traffic jams or weather conditions from the public authorities, the driver can focus on his/her task, i.e. driving.

According to what is expressed in D2.1 (Section 2.1), there are three types of business opportunities: (i) commercialization of the platform, (ii) apps and services sale, and (iii) upsells, referring to the “freemium” approach. So, when SIMPLI-CITY is established and comes into play, the future business might look as follows:

- There will be a certain amount of SIMPLI-CITY enabled organizations/people publishing real time information. This information will all be stored in the SIMPLI-CITY Cloud Repository.
- There will be a certain amount of SIMPLI-CITY services ready for being executed and used in new services development. These services will form the SIMPLI-CITY API forming the basis for the pay-per-use license.
- SIMPLI-CITY claims for the collection of data from heterogeneous resources and its publication according to on-demand requests. This enables a new business for the data publishers who might charge per subscription or usage of data.
- The data stored in the SIMPLI-CITY Cloud Repository is always up-to-date and updates are constantly carried out. This means that the user pulling data from the repository for his/her driving purposes has always the latest valuable information. This allows the user to take his/her decisions based on *live data* instead of outdated data adding high value to the apps and services executed.
- *Live data* allows the user to modify her/his behaviour during a trip by recognizing potential occurring obstacles (i.e. traffic jams, shortcuts, etc.), so that she/he can timely perform appropriate adaptations.

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