European Commission

Smart Cities

Stakeholder Platform

Multimodal personal mobility

Key to Innovation Integrated Solution

Multimodal personal mobility

Document information	
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ABSTRACT

The use of different and optimally combined transport modes within the trip chain in a seamless way (“fifth mode”) is one of the key approaches towards greater sustainability in urban transport. Each mode has its own advantages any may satisfy different trip purposes and needs. The core of new multi-modal urban mobility concepts is to combine public transport with other motorised and non-motorised modes as well as with new concepts of vehicle ownership. This involves car-sharing, bike-sharing and ride-sharing going along with the trend of sharing and using instead of possessing vehicles. Further it involves the use of innovative technologies, such as small size electric vehicles with two, three or four wheels as well as smart-phones and mobile apps to provide information and access to all modes.

Yet there are several obstacles to overcome, such as lack of information and data, separate responsibilities and parallel and unconnected systems each with their own entry barriers. In order to increase the user friendliness, several solution proposals within this key innovation are based on ICT based approaches such as mobile personal mobility assistance, web based multi modal information platforms, smart bicycle parking facilities and urban traffic control systems. Such applications involve booking and smart ticketing and could also allow the application of a mobility credit system in order to influence personal mobility and relieve congestion and space problems. Multimodality implies the development of new business models e.g. for the new sharing-systems and the role of the **mobility integrator** in order to overcome the traditional market competition and develop common benefits of the integration.

The deployment status of the solution proposals is quite heterogeneous depending on the degree of complexity and they are characterized by different innovation maturities. However, in order to provide seamless multimodal door-to-door mobility a strong focus is placed on user needs and possible barriers. By developing solutions in cooperation with the end user the barriers, especially for elderly and disabled people can be reduced.

Picture 1: Combinations of long distance rail, bike-sharing, public transport and taxi in Germany (Source: W.Schade)

INTRODUCTION

The Key Innovations (KIs) are a key output of the Smart Cities Stakeholder Platform. The Platform promotes innovation and is part of the Smart Cities and Communities European Innovation Partnership of the European Union. It aims to accelerate the development and market deployment of energy efficiency and low-carbon technology applications in the urban environment. The emphasis will be on their integration, which is a key challenge particularly for Smart Cities' technologies. The Platform aims to bring together technology providers, financiers and specialists in implementing smart city strategies at local level.

The expert Working Groups of the Platform on Energy Efficiency and Buildings, Energy Supply and Networks, ICT, as well as Mobility and Transport select from the spectrum of Solution Proposals (SPs) submitted by stakeholders[1] the *most promising and fundamental* solutions to accelerate the development of smart cities. The focus is on specific promising innovations, considered pillars or technical leapfrogs for integrated solutions in smart cities, thus promising, but standalone solutions, will not be developed into key innovation files and toolkits.

Regardless, if an SP will be part or not of a key innovation document, all solution proposals will be published in the Platform and linked to city profiles. The Platform is not an evaluation body and is open to all relevant smart solutions, large or small scale for cities and their inhabitants.

The aim is to promote through the preparation of a detailed document, a guide for cities on the performance of the innovation, including in some cases wider impacts on city life (such as change of behaviour, environment, social inclusion etc.). For each innovation, this key innovation document will describe the methodology to deploy it, including the technical requirements and the necessary framework conditions, such as existing infrastructures, technical expertise, regulatory requirements as well as the financial costs involved. The document aims to promote the adoption of the key technology and to identify barriers to deployment to assist relevant authorities in developing solutions to remove them. The document will list the technology providers as well as information of a number of potential financial sources by the EU and other bodies which have supplied information to the platform.

The information in the Key Innovation documents will become an integral part of the recommendations of the Smart City 10 Year Rolling Agenda document the Platform will draft for the European Commission. This document will highlight identified actions at European level required to promote the adoption of key innovations, such as the removal of regulatory barriers or recommendations on the focus of the Horizon 2020.

It is important to stress that this document is not a set of technical proposal or a full evaluation of the innovation, but aims to assist for cities to identify potential solutions and understand their context and implementation needs. It does not exempt or substitute a detailed cost/benefit analysis and implementation plans for cities that wish to introduce the innovation. The Stakeholder Platform cannot take any responsibility for inaccuracies or missing information or specific problems in the implementation of the proposed Key Innovations or other Solution Proposals.

[1] Solution proposals are published on the web site: www.eu-smartcities.eu/ solution-proposals

Description of a Key Innovation

A key objective of the Smart Cities Stakeholder Platform is to identify Key Innovations (KIs) for the development of Smart Cities. The selection of an SP as KI is based on the following criteria: **applicability, simplicity, affordability**, **usability,** the extent to which it addresses technology integration and if the potential impact is significant. Selected SPs will then be enhanced by the Platform's technical Working Groups (WGs) to develop KIs, adding the following aspects:

- Premises for the technology development and up-take (e.g. problems, what the technology is intended to achieve, other unforeseen benefits for the smart cities);
- Potential integration with other technologies and sectors, including use of ICT;
- If necessary, enhancing the information from the SP on the urban environment in which the technology can be applied;
- Key pre-requisites for the applicability of the key innovation, such as the required enabling environment;
- Instruments and market conditions needed to reach commercial viability.2

KIs will be completed by the technical WGs in collaboration with the Finance WG. This group will analyse the financial needs of the KI as well as their financial viability and bankability. The members of the WG will provide information on funding sources. The result will be published as a Key Innovation Toolkit.

The Toolkits thus provide practical solutions that can create an enabling environment for the application and replication of key innovations in a smart city.

[2] This includes a description of the main EU support instruments, such as the Risk Sharing Financing Facility

1. PRESENTATION OF THE KEY INNOVATION

Submitted to the platform at date (Innovation maturity)	Body(ies) submitting the proposal(s):	IP right holders:	Problem addressed	City (ies)	Parties or stakeholders involved:
1. SMILE simply mobile - Integrated Mobility Platform with Personal Mobility Assistant					
3 Oct 2012 (Pilot Project)	Stefan Gara **ETA** (A)	Project consortium under the lead of Wiener Stadtwerke AG	Easy access to individual (e-) mobility services and public transport Information, booking, pay-ment and use for different transport modes from one service integrator	Vienna Graz Linz	Wiener Stadtwerke, Wiener Linien (public transport) ÖBB (Austrian Federal Railways), car & bike sharing provider, software developer, research institutions
2. Selective Priorisation for Buses in urban context					
18 Sep 2012 (Best Practice)	Jose-Carlos Riveira-Martinez **Schneider Electric** (F)	Schneider Electric	competitivenes s of public transport, Modal-shift enabler	Valladolid, Vitoria-Gasteiz, Madrid, Jerez, SanSebastian, Barcelona	IT provider, city government
3. Facility Assigning Credits for Urban Mobility (FACTUM)					
6 Oct 2012 (Project Idea)	Riccardo Scopigno, **ISMB** (I)	Riccardo Scopigno, **ISMB**	Traffic congestion in urban areas lack of (flexible and scalable) incentives to multimodality	Not yet implemented. However it can rely on existing solutions (e.g. London Oyster)	software developer, inhabitants, city government
4. OPTIMOD'Lyon - Optimised urban mobility for passenger and freight					
5 Oct 2012 (Pilot Project)	Anne Charreyon Perchet **MEDDTL** (F)	Lyon conurbation (Grand Lyon) for data; private companies for software, sensors; psycho-sociologists for mobility behavior	Reduce traffic congestion and improve mobility information services in urban places		local administration body, software developer, research institutes, sensor providers

		analysis; research institutes for optimization algorithm			
5. Intermodal mobility chains for people with special needs (SIMBA)					
5 Oct 2012 (Pilot Project)	Nina Reichwaldt **BITZ Germany**	Project Consortium under the lead of Braunschweiger Verkehrs-AG	mobility options for elderly people/ people with special needs	Braun-schweig	public transport operators, social service providers, psychologists, software developer/ architects, medical informatics (research), state initiative concerning the end users, user with special needs
6. Low Lijn Amsterdam					
9 Jan 2013 (Pilot Project)	Pascal van den Noort **Velo Mondial / Master Plan BV /**	Master Plan BV /Pascal van den Noort	Bicycle Parking in Amsterdam is becoming a huge challenge with 70% modal share; Low Lijn is a format also for other areas in Amsterdam and other cities	Amsterdam	Velo Mondial / Master Plan BV / VenhoevenCS Architects / Decisio Economic Advisors / Neighbourghood businesses, institutes and inhabitants/
7. eMORAIL – Integrated eMobility Service for Public Transport					
30 Jan 2013 (Pilot Project)	Stefan Gara **ETA (A)**	Project consortium under the lead of the Austrian Federal Railways (ÖBB)	Integrated (e-) Mobility services to organize the interface between long distance- and first/ last-mile mobility for commuters	Viennaand Graz in combination with rural municipalities	ÖBB (Austrian Federal Railways) and 12 project partners for IT solutions, charging infrastructure, research, design, etc. (see www.emorail.at)

1.1 Description of the innovation and rationale for selection

The SPs have been selected based on the following evaluation grid:

Evaluation Criteria (Score: 1 to 5)		Weight
1. Impact over GHG emissions		25%
1,1	CO2 reduction,	
1,2	Increasing share of renewables,	
1,3	Increasing energy efficiency	
2. Economic issues/ cost-benefit-ratio		25%
2,1	Affordability (mobility costs for end users)	
2,2	Economic viability (period for return of capital)	
3. Smartness of Innovation		25%
3,1	Innovative nature/ progress to the state-of-the-art	
3,2	Integration into the urban transport system, handling existing (infra-) structures	
4. Potential for market uptake and replication/ customers experience		25%
4,1	Potential for scale-up and replication	
4,2	Barriers to market entry (e.g. vendor lock-in or non-interoperable protocols and rules)	
4,3	stakeholders involvement/ consumers attractiveness (e.g. user-friendliness of the technology)	
Total Score		

The result of the evaluation by all WG members of the SPs selected for this KI was as follows (scale = 1 (lowest effect) to 5 (highest effect)):

criteria	SP#1	SP#2	SP#3	SP#4	SP#5	SP#6	SP#7
1	2.92	2.33	3.04	2.81	2.13	2.85	3.53
2	3.33	3.50	2.54	3.50	3.27	3.52	3.08
3	3.75	3.33	4.04	3.08	3.46	3.19	3.94
4	3.25	3.67	2.56	2.67	3.13	3.21	3.26
total	**3.31**	**3.21**	**3.04**	**3.01**	**3.00**	**3.19**	**3.45**

In an ageing society also the needs of travelling people are changing. For convincing car driver to use an alternative mode or participate in a multimodal travel chain it is important to integrate current systems in order to enable seamless multimodality (fifth mode).[3]

This involves the provision of up-to date information especially on the accessibility of public transport infrastructure, car and bike sharing systems, but also taxis. Smart ticketing systems are important to guarantee easy access. Mobile applications and platforms can help to achieve this.

The seven SPs described above are all aiming to integrate technologies in order to encourage the multi modality for public transport users, motorists, cyclists and pedestrians as well as logistic companies. Important tools are user specific smartphone applications which provide users with information on their individual mobility options extended by booking and smart ticketing. This includes also on-trip information on parking options and can be extended towards the location of EV charging poles. Linkages of this KI exist with e-mobility, i.e. the use and integration of small electric vehicles into the multi-modal transport chains like pedelecs and electric two-seater urban vehicles.

In cities (or city districts) with high congestion and space problems, a system of credits to influence personal mobility can be applied. Credits could be earned by people when using specific modes of public transport, an extra-urban parking facility or as an award for avoiding a congested route. Those credits could be spent as discounts on transport facilities or to purchase the right to enter a restricted traffic area (SP # 3).

An important pilot project for this key innovation is carried out in the Greater Lyon Urban Authority, OPTIMOD'LYON. It sets up a multi-modal information platform integrating multi-source data for different modes and services, such as carpooling, carsharing, bikesharing, and time scale (historical, real time and predictive data). This

[3] see Schade, W.; Rothengatter, W. (2011): Economic aspects of sustainable mobility. Study for European Parliament. and Schade, W, et al (2011): VIVER – A sustainable transport vision for Germany. Working Paper Sustainability and Innovation No. S3/2011. Fraunhofer Institute System and Innovation Research.

aims at reducing traffic congestion and improving mobility information services in urban areas for people and freight operators. Three services will be plugged on this platform: a predictive tool, a multimodal GPS with real time and predictive information and a freight navigator (SP # 4).

The pilot project SMILE to be carried out in Vienna and other Austrian cities provides an integrated mobility platform with a personal mobility assistant which will allow end-users to get real-time information for their multimodal travel chain, to book all transport modes needed and to receive the necessary tickets and access codes. In this project innovation is driven by public transport operators (SP # 1). The predecessor of SMILE is eMORAIL, where commuters use electric cars - which are used during the day by companies for their business - to reach the nearest station, where they switch to the train to town and there use public transport or e-bikes for the last mile. (SP # 7).

Beyond that there are some accompanying elements to improve multimodality and favour public transport and soft modes compared to the car, such as the best practise of selective bus or tram prioritisation in urban context (SP # 2). Another element that keeps away many people from using bicycle is the safety issue or bicycle parking congestion. There are many projects on “bike stations” tackling both issues. One promising approach in Amsterdam is the creation of a specific bicycle parking garage involving specific amenities (SP # 6).

However the project ideas, pilot projects and best practices cannot be simply applied everywhere but depend on certain conditions, such as the readiness of different stakeholders to cooperate. Also the involvement and support of the city government or a regional administration body is crucial. Successful implementation of multimodality should also depend on implementation of the same system or similar and interoperable systems in several cities, nationwide implementation or even European wide implementation.

Moreover, when developing and applying these innovative ICT based tools the user’s perspective needs to be kept in mind. Special attention is needed towards the barriers for people with special needs (e.g. elderly or physically disabled persons): They are partly missing accessible infrastructure and up-to-date information and they often simply do not know about options to access personalized information on intermodal mobility chains. Therefore it is crucial to provide personalized up-to-date information about accessible infrastructure in an easy way (which has to be developed including the end users). Furthermore there is the potential to provide new services to support the mobility. These social services can be integrated in mobility/ transport services and support the attractiveness of public transport. (SP # 5).

Potentially the Key Innovation leads to modal shifts away from private road transport as well as optimised traffic flow and reduced road infrastructure capacity needs. This leads to reductions of GHG emissions and energy savings.

1.2 Deployment status

The deployment status is quite heterogeneous since the SPs involved tacking issues on different complexity levels and they are characterized by different innovation maturities.

OPTIMOD’LYON has already defined its mobility data platform (historical, real time, predictive for various modes - train, urban PT, parking - and mobility services - bike services, carsharing, carpooling services) and its availability policy to private bodies. The three applications are under development with a group of 50 users that will test mid 2013 the “multimodal GPS” after having providing guidance for its HMI. Autonomous business models will be investigated and tested with users. The implementation is planned in 2014.

SMILE has completed a comprehensive analysis phase and the overall design of the integrated mobility platform and personal mobility assistant. Currently (April 2013) the detailed specifications and the usability design for the software development are being finalized so that programming will start soon. In parallel rapid prototyping for the personal mobility assistant which has started already in 2012 allows to test usability

design ideas and functional features. Prototype releases are tested with selected test users. Pilot operation with a fully functioning prototype of the Integrated Mobility Platform will start in April 2014 with a large user group. After the research project, which ends in March, 2015 a broad roll-out of the system is envisaged. SMILE is funded by the Climate and Energy Fund of the Austrian Federal Government and linked with VAO – the Traffic Information Austria and other smart city projects in Vienna.

FACTUM is still a project idea. However it offers a potential flexibility in the development and deployment for two main reasons. Firstly, it might integrate any components of transportation system (parking areas, highways, metros, urban trains, buses, limited traffic areas). This has important implications on the deployment of the solution which becomes flexibly modular: in different cities (depending on the local context) can involve different stakeholders and transportation trunks. Secondly, the idea does not foresee an integrated ticket-management, but rather an integrated fare management: the difference is only apparently negligible, because, as a result, a fully integrated billing system is not required, while credits (as a sort of "roaming") are easier to be agreed among the stakeholders. This may indeed simplify the stakeholders' involvement and, consequently, the practical feasibility.
There are examples of solutions which it can be integrated in FACTUM. It does not require an integrated ticket, however, when it exist, it can be used as starting point. With FACTUM, integrated cards (as London Oyster[4]) could be used also to redeem credits, thus rewarding both multi-modal travelling ("the more you use it, the less you will spend") and driving behaviours (e.g. discounts for parking lots close to metro stations) – by adding additional components (such as GNSS positioning and smartphones for itinerary negotiation).

SIMBA focuses on supporting mobility of people with special needs, especially the elderly. A survey based on questionnaires had been performed to apprehend mobility requirements of older people. The survey involved more than 240 people from different age groups (55-64 years, 65-74 years, 75 years and older). They could identify relevant aspects concerning characteristics of public transport facilities (e.g. benches at the bus-stop) and points of interest (e.g. public conveniences). Furthermore it had been shown that paper-based information material is still the main tool for travel planning. Anyway electronic resources are in use, in fact in all age groups considered. Another aspect identified in SIMBA is the integration of a service provider who supports the user's mobility. The technical architecture to implement SIMBA is defined already. The next step will be the implementation in cooperation with end-users and create business models in cooperation with different stakeholder (transport providers, cities, services providers). SIMBA is funded by the German Federal Ministry of Education and Research.

Generally for deployment the municipal contexts of sustainable urban mobility planning should be considered. There also close links to issues such as clean fuels, demand management strategies, mobility management, safety & security, less car dependent lifestyles, urban freight logistics and telematics.

The Solutions Proposals are deployed as follows:

Valladolid and Vitoria:

During the Bus-Direct project, selective prioritisation was one of the main issues. Prioritisation, even for public transit is always disturbing for traffic conditions. Bus-Direct project implemented alternative prioritisation techniques, by enhancing the collaboration level between public transport and traffic control centres, in order to leverage existing positioning and regulation systems towards an increase in regularity and quality-of-service, by detecting, analysing and deciding on prioritisation by balancing needs and drawbacks in highly congested city centres.

Vienna, Graz and other Austrian cities

[4] London Oyster Cards are plastic smartcards which can be used instead of paper tickets to pay for journeys on bus, subway, tram, DLR, London Overground and most National Rail services in London.

In these cities, SMILE is planning to start pilot operation of its Integrated Mobility Platform in Vienna, Graz and possibly Linz in April 2014 until the end of the year. Public transport, e-car sharing, city bikes and other modes of transport will be provided. Test users will be able to use the Personal Mobility Assistant for their city trips but also for travelling between the cities or commuting to the cities from the surrounding urban area.

eMORAIL pilot operation in rural areas as well as the bike sharing service in Vienna is running since September 2012. The commuters in the rural areas are using the shared e-Car for the first and last mile (from home to train station and back) while the business users utilize them during day. The eMORAIL smartphone app is the control centre for all users (car reservation, charging status, train delays, sos button). The city pilot with the eCar-Sharing service in Vienna and Graz is starting in May 2013.

Lyon

OPTIMOD'LYON first trials are running for the predictive information The trials for personal "multimodal GPS" (real time multimodal navigator) and for the freight navigator are going to start in June 2013.

Amsterdam

The bicycle boom has lead to the problem of bicycle parking congestion at a number of squares and stations. Bikes which were constantly parked everywhere, became a major hindrance, and even a public safety hazard (by blocking roads and emergency exits). The city decided to take action in the Leidseplein neighbourhood. The 'Low Lijn (= low line) Amsterdam' not only provides for an innovative bicycle parking solution, but also creates green space as well as a monumental and bike-free square. The low Lijn is now considered as one of the best alternatives to all on-street parking solutions.

Braunschweig

Braunschweig is a city in northern Germany offering different modes of public transport (busses, tramway) which also comprises the region. Braunschweig has a high reputation in the fields of "eHealth" and "Ambient Assisted Living (AAL)". There are a few organizations around Braunschweig working for several years on various concepts for an independent and self-determined life in old age. Together, they are going to build up a network for supply and services for independent living. According to this, mobile personal mobility assistance as aimed in SIMBA are necessary for an integrated approach in this field. The database for SIMBA system is going to cover a special neighbourhood of Braunschweig first which is selected by the age structure. First trials are going to take place in this neighbourhood. Second the database is going to be broadened to other areas of the city.

1.3 Technical feasibility and viability

This section describes the technical approach of the solution proposals forming the KI. The description is divided into two parts, one describing the present status of the SP and the second one elaborating on their role as an emerging solution for smart cities.

SMILE (SP#1)

Present status:

The SMILE project goal is the development of a prototype of an Integrated Mobility Platform with a Personal Mobility Assistant as user interface and open interfaces ("connectors") linking mobility service providers (e.g. public transport, car- and bike-sharing, taxi, charging-stations etc.), information systems like VAO (Verkehrsauskunft Österreich) or GIP (geo localisation system) to the Platform.

In order to create the foundation for a broad future participation of partners, currently the Platform Connector – the open interface to the platform – is developed and tested. It will result in "Platform Connector specifications" to be used in the future by system

engineers and application programmers. During the project we will partner with existing e-mobility projects and mobility provider to link them with the SMILE platform. This may foster joint developments and provide real test cases for the SMILE connectors.

Emerging solution for smart cities:

SMILE is aiming to contribute to and facilitate a new emerging multi- and intermodal mobility system (e-car sharing, e-bikes and charge&park), where all available mobility service offers could easily be used and combined to best serve customer mobility needs. Thereby it makes multimodal trips as simple as possible, which is a prerequisite to transform the transport system of a smart city.

The service integration provided by the Integrated Mobility Platform will allow the user not only to receive personalized real-time information for all mobility needs but also to book and pay all required means of transport and to use and access them. The main user interface and unified key to this personal mobility will be the Personal Mobility Assistant, an innovative application on the mobile smart phone. The PMA should make it simple to use multimodal mobility services and provide a great user experience. Thus SMILE strategy, design and development is focused on user needs.

It will make sharing solutions much more attractive so that they could become standard traffic solutions for housing blocks and city districts. It supports the creation of multimodal transport hubs e.g. around main stations as the Integrated Mobility Platform is a key means of dissemination for such solutions. It closes the gap between the potential users and the mobility service offerings eliminating information current barriers in multimodal traffic.

The final objective is to build upon the project experience including scientific monitoring and user experience data and evaluation to deliver a roadmap for a further development of the Integrated Mobility Platform.

Selective Bus Priorisation (SP#2)

Present status:

The BusDirect project, already implemented in Valladolid, Vitoria and other significant cities, provides interaction between bus fleet management systems and traffic-light center, considering the main goal of making the bus/tram network more attractive for city mobility by leveraging existing systems and improving/maintaining quality-of-service (intervals regulation) independent of overall congestion and by applying specific, time-limited actions on priorisation requests.

Pilot projects demonstrated:

- The need of such techniques, according to analysis of requests and distribution along typical days and specific conditions (usually peak hours)
- The suitability of priorisation actions by providing lower fluctuation in quality indicators over critical periods, reverting on users satisfaction
- The efficiency based on measurements of fuel consumptions and emissions from busses
- The low impact on overall traffic situation by deciding on Priorisation actions, both where and when to apply, based on balance for cost/benefit with other city users (private cars and pedestrians)

Emerging solution for smart cities:

As part of the smart cities strategy, promotion of public transport and advancements in intermodal strategies are key issues to be addressed. In essence, this SP focuses fostering attractiveness of public transport in medium cities as part of a global non-disruptive approach towards reduction of private traffic for trips with origin/destination in city centers.

FACTUM (SP#3)

Present status:

FACTUM concept has been included in a national Project Proposal for Smart Cities. It has just entered phase 2 of the evaluation.

Emerging solution for smart cities:

From a technical point of view FACTUM can be realized in different ways. At the current stage of the proposal the following components have been identified:

1. A software to be installed either on a smartphone or on the navigator: based on the destination the traveller will receive credits for preferred route aimed, for example, at unloading a congested area or switching to a multi-modal itinerary (e.g. using a parking lot and catching a metro instead).

2. A system for the practical management of electronic credits (e.g. temporary codes associated to a specific USIM or plate, for discounted fares on a specific parking area, for bus ticket or access to a reserved lane).

3. A policy for the management of credits: in the simplest case an agreement among stakeholders (e.g. between a traffic operation centre, a metro operator and parking owners); in the most complex case an “umbrella” software aimed at the overall optimization.

4. Optional components may be required for specific integration: e.g. camera for automatic plate recognition, wireless communications or electronic gates (e.g. for restricted-traffic areas).

5. A traffic simulation platform, finally, could optionally complete the solution making it real-time. For example, the most effective (and dynamic) policy for credits could be real-time computed to react to traffic jams or to manage multimodality depending on the state of buses and metros.

Altogether, feasibility is not a technical matter and, even more, a simple scenario may require little effort.

Last but not least, while FACTUM does not require an integrated ticket, however it does not compete with them. Consequently FACTUM will not cause the obsolescence of integrated ticket but, conversely, it could preserve and revitalize them, thus benefitting from the investments made. Integrated cards, in fact, could be used to manage (redeem and spend) credits.

Information for intermodal mobility
(SP#4 and 5)

Present status:

The possibility to get information on accessible infrastructure is already given in Braunschweig. However this information need to improved. For example there is less information on emerging facilities, passenger shelter, lighting or quality and state of the street. If it would be available, it could support mobility especially for the elderly. Furthermore information is usually focussed on a separate mode of transport. Not only multimodal information should be focussed but also the providing of supporting services (e.g. provide information service by calling a service centre).

Emerging solution for smart cities:

There can be a solution which supports mobility in different kinds of transport. In SIMBA there will be implemented a smartphone- and a web-application. These can be used to access information on public transport, walking and taxi. Furthermore it provides supporting services, which can be location based. To use this application the end users have to install an application on their mobile device or use the web-application. There should be the possibility to personalize the information by using different profiles. The

backend solution has to deal with different data sources to provide intermodal information

Parking facilities for green modes (SP#6)

Present status:

The Low Lijn is in the political decision making phase. The process will take some time since it is a daring concept in Amsterdam, where a floor will be projected just above the water line of a canal that already has been partly covered. The floor with bicycle racks will be about one meter below quay level. On the roof a public garden, at about 1 meter 50 cm above quay level will be planted.

The reception of the Low Lijn Bicycle Parking garage will be a lounge where people can hand their bike to a bike butler, use make-up mirrors and sanitary facilities, lockers, Last Minute ticket terminals, restaurant booking points and shopping delivery point will be there for all. A police point will guarantee the feeling of safety.

Touching the canal is the contentious issue and brings technical challenges to the water household of Amsterdam. Both matters can be solved if there is a political will.

Emerging solution for smart cities:

The Low Lijn brings bicycle parking in a new realm of urban planning; it will no longer be an add-on for limited cycling in a city, It will become a structuring tool. The Low Lijn challenges to start planning in this way in an early stage and no wait till problems occur. In Amsterdam parallels with car parking in the eighties and nineties come to mind.

eMORAIL (SP#7)

Present status:

The eMORAIL pilot trial in the rural area as well as the bike sharing service in Vienna is running since September 2012. The commuters in the rural areas are using the offered e-Car for the first and last mile in the morning and evening, while local businesses use them during day.

The city pilot with the e-Car-Sharing service in Vienna and Graz is starting in May 2013.

eMORAIL is also seeking a further roll out of it´s services by identifying possible mobility corridors based on number of commuters, train stations, travel distances, etc.

Emerging solution for smart cities:

eMORAIL focuses on commuters (living in rural areas and working in cities) and their daily mobility behaviour. This has a big potential for cities and communities to decrease car usage and encourage multimodal mobility. In rural areas where public transport is less dense first / last-mile cars sharing (pooling) services can be very attractive as a “personal shuttle” to public transport hubs

1.4 Financial analysis

This section presents an initial financial evaluation, based on the estimations of the solution providers.

Estimated timescale

SMILE (SP #1) is a research project where the prototype of an Integrated Mobility Platform will be developed. The project will end in March 2015 after which it is intended

to develop a broad commercial solution with an estimated time horizon of 2 to 3 years. However all available relevant technologies should be developed and tested with the prototype

Given its modularity, FACTUM (SP #3) would well fit a two-year framework to demonstrate the feasibility, by a subset of all the possible functions. For example the integration between parking lots, metros and traffic management centres

Information for Intermodal mobility: OPTIMOD'LYON (SP # 4) started in 2012 and completed in 2014, has planned first implementation in 2014. Due to the scalability of the three innovation, implementation will focus on solutions and functionalities proven as robust enough to support business models autonomous from public funding. The project expects a €83 m turnover generated by the 8 private bodies that will deploy the innovations tested.

It is important to create business models in cooperation with different stakeholders (transport providers, cities, services providers). SIMBA (SP #5) is planning to start developing business models end of 2013 and is going to come up with a potential solution in late 2014.

Parking facilities for green modes (SP # 6): The Low Lijn is planned to be realised in 2017. The first phase is the political decision making process in 2013. On this base the design can be done in 2014, followed by its decision making process in 2015. The construction can start in 2016.

eMORAIL (SP #7) is a research project that started in 2011 and will end in October 2013. The operational service model and the smartphone application are ready and are currently tested in real life. Further commercial applications are under investigation.

Example of some key timetable aspects:

The SMILE project (SP #1) started in March 2012 and will last for three years until February 2015. Pilot operation will start in the first quarter of 2014. A commercial roll-out plan depends on the strategy (starting with key features and some key partners) and the local and regional framework conditions.

As described before, the eMORAIL (SP #7) roll out concept and business model(s) are currently in progress. Therefore, the key timetable aspects are decisions on the next steps, details on the business model (operating company, fleet management, service provider, etc.). Final decisions will be made by the end of 2013.

Due to the large set of possible functions of FACTUM (SP#3) a target sub case should be carefully selected to fit a 2-year schedule, getting in advance the commitment of the stakeholders involved. This represents also the main criticality. The main points of strength lay in the modularity of the solution (several options are available) and in its scalability (a FACTUM architecture could grow over time and preserve investments). A longer duration (e.g. 5 years) would lead to a more complete integration of the multi-modal transport.

The SIMBA project started in February 2012. The three year schedule will come up with a business model and a running software solution by the end of 2014. To achieve this it is important to capture requirements of users and stakeholders in an early phase. Based on these requirements appropriate providers have to be identifies and involved.

Parking facilities for green modes (SP # 6): The design is relatively simple, be it innovative in its genre. The decision making process costs time. People have and definitely will take the opportunity to appeal and this will cost time

Analysis of key risks

SMILE (SP #1):

- Participation of many mobility service providers to fulfil the promise of real multimodality (the more the better user acceptance will be)
- Number of partners increase complexity
- Willingness to pay for the service of the platform (users and/or partners)

BusDirect selective Priorisation (SP#2):

- Participation/collaboration of public transport concessionaires and traffic management centers
- Agreement on objectives: balanced benefits, quality-of-service for public transport (no real commercial-speed increase)
- Clear willingness to promote public transport, considering future investments for responding to demand

FACTUM (SP #3):

- Identification of the most effective intermodal credit, suitable for FACTUM paradigm – this is city-dependent.
- Involvement of key stakeholders to make multimodal credits feasible. This requires some agreement which the (two or more) Transportation Companies may benefit from: perhaps there should be a driving roles of Governments managing credits as financial supports to the companies.
- Financial analysis of the sustainability of the credits – not to unbalance the revenues of each Company involved.

SIMBA (SP #5):

is based on existing information systems which are going to be extended by information relevant for people with special needs. To realize this approach existing systems have to have the possibility to be flexibly extended.

Parking facilities for green modes (SP # 6):

The key risk is the small but powerful group of monument protectors who will take all legal means to obstruct this plan

eMORAIL (SP #7):

- Commuter acceptance and the willingness to change mobility behaviour to a multimodal and public transport-based mobility
- Willingness of commuters and business partners to share e-Cars
- Finding an adequate general operator

The scale of financing required

As for SMILE (SP #1) a serious cost estimate is not possible at the moment. However it is likely that development and operation of the platform is not so much depending on the number of users and partners. The research project has a budget of € 6 mill. A two digits million range as development costs for a broad Austrian-wide roll out is estimated.

FACTUM (SP #3):

Supposing a solution where limited hardware were required and mainly software development, a funding corresponding to a medium-sized European project (such as a Specific Targeted Research Projects - STREP) should be sufficient to carry out most of the work and to test the solution. In this case (where limited hardware were required) the extension to new cities should be not particularly expensive and would depend on the ownership of the components already in place and on the analysis of the specific urban context.

SIMBA is financed by the German Federal Ministry of Education and Research for three years with a project volume of € 1.7 mio. Financing details on a running solution will be investigated during the project.

Parking facilities for green modes (SP # 6): The Low Lijn stays well within the planned budget (for an underground parking garage) of € 17 mio. For now the estimation is € 9 mio.

As the project eMORAIL (SP #7) is still running, market analysis and simulation are in an ongoing process. It was shown that the price of the eMORAIL Mobility package as well as included services are very important for the commuters and further for the cost-benefit ratio of the future operating company. Further details will be available in October 2013.

1.5 Suitable city context

SMILE (SP #1):

An Integrated Mobility Platform as it will be developed in the SMILE project might be implemented in cities where a broader range of different means of transport are available, public transport alone might be too narrow. Crucial is the willingness of the mobility service provider to cooperate in marketing and sales through the platform. An open standardised interface to link to the platform is helpful. Clear rules and a clear business model help to reduce reservations especially of small mobility service providers. A comprehensive marketing campaign targeted to the end-users is needed to get a broad participation and to convince them to use the Integrated Mobility Platform as their main tool for multimodal mobility.

BusDirect Selective PT Priorisation (SP#2):

Cities with already implemented or (nearly) completed surface public transport network which are suffering from service degradation due to interaction with private traffic are suitable for such projects. Existing systems should be in place both for PT management and regulation and traffic control, considering suitable developments for real-time interaction. At this point, and based on first results, critical corridors or even city-wide deployment may be planned and advertised as it should have direct impact on private traffic aimed to reduce congestion by providing alternative efficient mobility media.

FACTUM (SP#3):

The solution should be pretty replicable. A city of about 1.000.000 people would be suitable: this is the dimension which may need such a solution and where some building blocks could be already available. Torino or Milano in Italy might be suitable. Cities like Vienna, given their infrastructure, could be suitable as well.

Information for Intermodal mobility (SP # 4 und 5):

OPTIMOD'LYON most important results, relies in the definition of clear roles between public and private bodies. The public bodies that are in charge urban mobility policy take in charge multimodal traffic management and data gathering and provision. The private sector provides technology and uses the mobility data platform to test and implement solution. Public bodies provide assistance to private companies to help them to set up autonomous business models. Thus the stress is put on the data quality and its completeness (all modes, timescale, full geographical coverage …). The access to the huge urban mobility dataset is automated and easy to do with the restriction of compliance of the services with the mobility public policy. Some data are provided with the subscription fee to avoid monopolistic situation and to allow SME to develop business while keeping a competitive and innovative environment.

The SIMBA solution can be implemented in nearly every city. If there is no such database, information which is relevant to support mobility has to be collected (e.g. accessible infrastructure). The support of local transport providers is crucial. It is

important that the transport and service providers integrate the solution in their portfolio. Furthermore end users have to be involved either by cities or state institutions or service/ mobility providers.

Parking facilities for green modes (SP # 6):

The concept of the Low Lijn does provide a solution for bicycle parking, but much more fits in a wider concept of improving the quality of the entertainment area, making it more safe and attractive. It is more a Bicycle Cloakroom, where you not only leave your bike for the evening, but also prepare for the evening, agree to meet friends before going out in the area, report any incidents and get a sense of safety. This concept starts from the purpose of the area and fits in a spatial planning concept. A neighbourhood cooperative enterprise will be set up to assist the city with their planning efforts. With regard to the city context it is very important to start from the neighbourhood's ambitions and have the vision to plan for people rather than just look for technical solutions.

eMORAIL (SP # 7):

The eMORAIL solution fits for almost every city with a considerable number of in-commuting employees, good public transport and good accessibility by train. It needs cooperative public authorities in the selected communities as well as the cooperation with public transport, P&R infrastructure and car sharing providers. The pilot cases employees commute more than 40 km per day to the next city. Travel distance (last / first mile) from their home to the next train stations is between 7 and 15 km.

2. EXPECTED IMPACTS

This section presents the information on impacts supplied by the solution proposal as well as the expert assessment by the relevant working group members.

2.1 Energy supplied or savings expected

- Strong potential for energy efficiency will result from shifting individual motorized mobility to public transport and (e-)sharing systems.
- Strong potential to increase share of renewable energy sources is the switch of the energy mix for public transport.
- SMILE and eMORAIL are promoting energy efficient means of transport. The greatest improvements in efficient energy use will result from shifting from individual mobility using personal private vehicles to trips using combined modes, with public transport and electric-based vehicles for first and last miles. However as there is a broad variety of choices a user can make it is not able to quantify the energy savings in detail
- The FACTUM architecture could be also coupled with electric vehicles and car sharing (promoting car sharing or a specific charging area, despite farther). This may lead to saving in the energy supply.
- There is an ongoing study on how the mobility could be affected by electric vehicles and charging spots location (Smart Grid): such information could also influence the decision on credits' assignment so to enforce energy saving.
- OPTIMOD'LYON expect a 6% modal split due to an accurate information on travel times and cost of the different modal options for individuals and commercial and freight fleets, and to the use of a multimodal GPS
- The Low Lijn will continue to invite people to come by bike to the centre of Amsterdam with the least energy consuming mode.
- The increased use of public transport in SIMBA can support energy saving.

2.2 Expected impact on GHG emissions

In general, the seamless multi-modality is expected to reduce GHG emissions of transport. Most important will be that transport users are supported to use the vehicle that best suits their transport needs, which in many cases will be a small energy efficient vehicle instead of their own big car or a combination of public transport with other modes like walking and cycling.

- Strong interrelation with the increase of energy efficiency discussed in 2.1 and shift of the fuel mix;
- The approaches to promote the use of sustainable modes within a multimodal trip chain will decrease GHG emissions;
- Decision to implement credits (FACTUM) may also influence emission or even be taken based on the monitored state of pollution;
- Optimod'Lyon expect a yearly 220,000 t of CO_2 saving with the modal shift gained through accurate multimodal information and optimized commercial and freight fleet operations;

- SMILE will support the city of Vienna's target to reduce the share of private cars in the modal split, which is a key target in Vienna's Climate Protection Program;
- Prioritisation for public transport is also focussed on modal shift, as part of making it more attractive to users by providing higher quality-of-service based on regularity;
- SIMBA supports public transport instead of using individual motorized transport facilities. This may reduce GHG emission.

2.3 Interfaces with other technologies/ transport modes

Within this topic area of multimodality several interfaces are possible, virtually, with all possible factors influencing mobility.

Better multimodal choices will result from greater integration of the modal networks: airports, ports, railway, metro, bus stations and car / bike sharing stations should increasingly be linked and transformed into multimodal connection platforms for passengers. In Optimod'Lyon, road traffic, parking availability are fully integrated in the whole set of urban mobility dataset, in order to provide to the road user all the potential of alternatives modes, sometimes including road traffic services.

Moreover they are interfaces with specific traffic facilities such as parking lots, restricted traffic areas, as well as with online information and electronic booking and payment systems integrating all means of transport should facilitate multimodal travel.

Public transport prioritisation is already highly related with collaboration between different transport modes. The interfacing between transit and traffic systems allow optimized management of prioritisation requests, together with existing traffic, by balancing accordingly the effects of both modes. Interfacing for Bus-fleet management and traffic control systems has been defined in order to ease info exchange, as part of the Bus-Direct project.

2.4 Wider potential benefits for cities

The wider potential benefits include the following, which have not been quantified in monetised values by the solution proposals:

- Decrease "mobility poverty" especially for commuters who depend on cars via last/first mile mobility services.
- Decrease public space occupied by cars
- Decrease air pollution and CO_2 emissions
- Decrease social costs of road congestion
- Foster transit services by higher regularity and quality-of-service
- Improve quality of life of citizens
- Improve health by supporting social participation of citizens
- Improve acceptance of people with special needs
- Improve attractivity to tourists
- Decrease sound levels

- Increase social cohesion
- Improve economic opportunities.

2.5 Other expected impacts

Traffic congestion and mobility efficiency are expected to get improved, leading to a stronger governance of mobility and urban sustainability.

SMILE will provide the citizens of Vienna with a concrete tool that let them experience what smart city solutions look like. Using state of the art ICT the Personal Mobility Assistant provides a new user experience in the field of multimodal mobility. The PMA knows the preferences of its user and learns his mobility patterns to support him even better. As new multimodal mobility offers will be simple to use SMILE contributes significantly to transform the urban mobility system into a much more sustainable one.

OPTIMOD'LYON data platform allows Lyon conurbation to become a remarkable place for testing innovations and implement new mobility solutions. The completeness of this data platform (all modes and mobility services, historical, real time predictive information) and the standards used make life much easier for private bodies that need to test their innovations.

The Low Lijn will spur the development of cycling parking / planning in the context of sustainable urban mobility planning and urbanism.

In addition to impacts on energy saving and GHG emission SIMBA will improve quality of life and health of citizens as follows. By providing suitable information citizens are able to participate on social life in a self-determined an autonomous way.

3. ADDITIONAL REQUIREMENTS ON DEPLOYMENT

This section presents the requirements for wider deployment of the innovation. It indicates any potential barriers or risks facing wider deployment or replication elsewhere.

3.1 Governance and regulation

In general multi-modal solutions enabling a smooth integration of public transport, car-sharing, bike-sharing and ride-sharing including new business models of such systems are spreading in several cities in Europe as well as globally. This bottom-up approach bears the risk of setting-up a fragmented system in which a user of a multi-modal solution in one city is not able to use the similar system in another city. The vision of a fully-fledged multi-modal solution would be that an end-user has a contract with one mobility service provider that enables him/her to use all mobility options in his/her hometown, but as well in other urban areas, i.e. a one-stop-shop solution. This vision raises strong governance and regulation issues:

- Rule for “roaming” between mobility services of different mobility providers in different urban areas
- Provision of timetable information of public transport to mobility service providers.
- Standardisation of software/data interfaces to reserve and use vehicles.
- Access to mobility data both private and public, to facilitate completeness of multimodal services

These issues are still to be solved rather by national and European policy-makers, than by urban policy-makers. As for FACTUM, in the simplest embodiments, governance and regulation may not be involved. However a potential role of Authorities may unlock FACTUM’s full potential. In fact, it is known that in most Countries, local Governments financially support the Organizations which deliver transportation services. With FACTUM, these funds could be supplied (also) as credits to the users. In this fulfilment the Government would have a strong involvement (which should be committed in advance) but would also gain the ultimate control on the Smart City Transportation; in this case, additionally, the agreement might be simplified, being mainly between each Operator and the Government.

OPTIMOD’LYON has defined a full strategy for mobility data access, combining interests of public bodies (compliance with mobility policies and avoiding monopolistic situations), private companies (developing new businesses) and end users (easy the urban travel, decrease pollution generated by road traffic). This policy has identified 3 ways to access the data: open data, open data with uses restrictions (where compliance with mobility policies are critical), open data with uses restrictions and fare (to avoid monopolistic situation, with adequate fare rules).

As the Austrian Federal Railways are one of the partners in the SMILE consortium the project is aiming to provide at least a national mobility solution allowing end-users to travel seamlessly across the country. Routing information will be provided by “Verkehrsauskunft Österreich” (Austrian traffic information) which will include real time data for all public transport services in Austria and a complete road information system. Information for booking and payment will be directly provided by the mobility service providers linking to the platform. As SMILE is funded by the Austrian Climate fund the Ministry of Transport is a major stakeholder; a setting which allows discussing necessary regulatory issues and which may help to disseminate multimodal solutions. However up to know these issues have not been identified. A main goal of SMILE is the development of the platform connector – a standardized, open interface. This is hopefully supporting the development of a common data format which could be used

for different applications. This effort is supported by mutual contacts and collaboration with other European projects and large mobility service providers. Vienna has recently decided to not only provide timetable information but also real-time data for all public transport as open data.

Since SIMBA will provide individual travel recommendations users have to register and add themselves to a mobility profile. The profile describes user's needs. A user using a wheelchair is not able to use stairs, for example. These data has to be handled considering data privacy regulations. Furthermore location related data has to be handled and recorded concerning privacy regulations.

3.2 Stakeholders to involve

This section identifies the different stakeholder that need to be mobilised to successfully introduce the technology in the urban area, such as households, specific professional bodies, corporations, specific authorities (transport authority), etc,

Stakeholder	**Role/ how to be involved**
Mayors/ politicians	Modal-shifting policies
Regional administrative body	
City administration	Traffic management, public transport Priorisation rules, information providers
Railway companies	Data providers
Public transport companies	Data providers
Car-sharing companies	Emerging business, social networking, hourly car rentals,
Bike-sharing companies	Bike rental services
All other mobility service providers, e.g. taxis, car-rental, ships, mountain railway, parking facilities/charging stations	Service providers
IT providers/ software developers	Processing and dissemination platforms, service providers
Payment providers	Online payment service providers
research institutes	Advanced services development
Inhabitants/ end-user	Information provider/consumers
Financial institutions	Consortia partners for info dissemination premium services
Architects	Design
Economists	Cost Benefit Analyses
Social services providers	Provide mobility supporting services

3.3 Supporting infrastructure required

This section presents any prerequisite on the minimum pre-existing infrastructure required.

Relevant pre-existing infrastructure may be available as data and information has to be provided from available systems for public transport, traffic management may be already in place and extendable to prioritization, also suitable dissemination servers will output information to citizen or internal/external companies.

The development of services are the fundamental part of the multimodality opportunities, enabling inhabitants and other end-users for mobility decision taking on-trip.

3.4 Alignment of administrative levels involved

Implementation of KI's in cities will be supported by funding mechanisms and other (policy) incentives at different administrative levels: city, national and EU. However, some initial interviews on the challenges that cities face during the roll out of sustainable mobility projects indicate that the supporting frameworks at the city, national and EU-level are not always optimal aligned. This is especially evidenced by the preliminary evaluation of several urban electro-mobility initiatives.

City officials indicate that successful implementation of sustainable mobility initiatives requires a highly flexible tailor-made approach; especially through cooperation with local key-stakeholders. This approach involves flexibility of implementation trajectories regarding: timing of roll-out, adjusting overall project size, as well as the possibility to involve (new) public and/or private partners. In contrast, national and EU administration levels typically aim to develop longer term policy frameworks that need to be uniform and shaped in a verifiable format, thereby limiting flexibility. The challenge for future incentivizing frameworks is to bridge the gap between the need for local flexibility and the aim for long term uniform and verifiable policies at the higher administrative levels.

4. POTENTIAL FUNDING SOURCES

The Finance Group of the Stakeholder Platform has prepared documents on funding models and the use of EU Funding instruments, either from the EU budget or from the European Investment Bank. The documents are freely downloadable from the Stakeholder Platform's website.

- For funding models please refer to the **"Financing models for Smart Cities"** guidance document.
- For EU supported funding instruments please refer to the guidance document on **"Using EU Funding mechanisms for Smart Cities"**.

This section presents specific recommendations for financing models and potential sources suitable for this KI.

4.1 Financing models suitable for the innovation

To speed up the innovation process, partial public funding is certainly recognised as a key requirement at this stage. It also allows project to be developed within a short time frame, test the viability of different parts of the project, and provides the necessary "glue" to build project team.

The intermodal transport systems can use a system of cost recovery based on user charges, such as the bike sharing charging systems. If the system is well developed and managed, the rate of operational cost recovery can eventually reach a level of full cost recovery. However, pricing is a key element of demand, and the benefit of the scheme in terms of emission reductions, congestion reductions, health benefits and other economically important impacts should be taken into account in the cost-benefit analysis. Social benefits can outweigh a cost recovery shortcoming caused by the limitations in potential user charges, in this case public support is warranted during the operation of the schemes. Where the aim is to reduce road transport in cities, multimodal bike and public transport alternatives can be supported by congestion charges for example.

4.2 Specific sources of funding for the KI

National or EU public funding is needed to develop the project. The multimodal system can have considerable environmental and health benefits, thus support is warranted.

Congestion charges are one of the potential sources of funding in addition of some user charges. Some management systems and specific components may benefit from research funding from the EU if innovative.

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