



EUROPEAN
ROAD
TRANSPORT
RESEARCH
ADVISORY
COUNCIL

ERRAC

The European Rail
Research Advisory
Council

European Research

Urban Mobility Roadmap

Foreword

Urban mobility is of growing concern to citizens. Nine out of ten EU citizens are of the opinion that the traffic situation in their area should be improved¹. The choices that people make with regards to their way of travelling will affect not only future urban development but also the economic standing of citizens and companies. The improvement of the efficiency of the urban mobility system will require a greater integration of the urban mobility network.

The technology platforms ERTRAC and ERRAC are fully aware of this situation. Both agree on the need to address the challenge of sustainable mobility in cities from an overall urban system perspective.

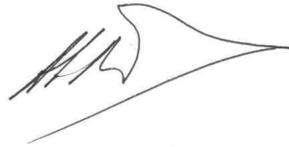
They have each developed research roadmaps on urban mobility as part of the two coordinated and support actions funded by the European Commission, "ERRAC ROADMAP" and "SAFIER" (ERTRAC). **This document brings together the work of the two platforms on urban mobility to present a coherent and integrated roadmap on the urban mobility system put forward by the stakeholders of the rail and road sector.** It demonstrates the importance given by the two sectors and the European Commission to a proper cooperation between the representatives of all the rail and road transport research stakeholders.



Wolfgang Steiger

ERTRAC Chairman

**Director future technologies
Volkswagen group**



Prof Andrew McNaughton

ERRAC Chairman

**Technical Director
High Speed Two Limited**

¹ Attitudes on issues related to EU Transport Policy. Flash Eurobarometer 206b, July 2007

TABLE OF CONTENTS

Foreword	2
1. Integrating the urban mobility system.....	4
1.1 <i>The integration of urban traffic and travel information.....</i>	4
1.2 <i>The integration of ticketing and charging services for all mobility related charges in the urban areas.....</i>	6
1.3 <i>Interchanges for passenger travel and transport.....</i>	9
1.4 <i>New city logistics concepts and interfaces for a more efficient freight delivery.</i>	10
1.5 <i>Integrating urban mobility management.....</i>	11
2. Developing services and infrastructure for the long term efficiency of the urban mobility system	12
2.1 <i>New mobility services.....</i>	13
2.2 <i>Infrastructure.....</i>	13
3. Supporting knowledge & innovation	14
3.1 <i>Improving knowledge with data collection and analysis</i>	14
3.2 <i>Strengthening the cooperation between stakeholders</i>	14
4. Understanding better the user behavior in the urban environment....	15

Large Urban Systems – with a population of a million and over – cannot successfully compete in a global economy without high accessibility to all facilities concentrated in urban areas.

To answer the challenge of an urban mobility system more effective, more reliable, providing better accessibility, and more energy efficient², it is important to ensure an optimum mix between the various transport options combining:

- short term measures improving transport services while serving the current needs of citizens within the current urban transport capacity constraints (chapter 1), and
- long lasting actions able to modify the city distribution of urban activities, to influence the behaviour of citizens and to allow the creation of new transport infrastructure (chapter 2)..

These options supporting knowledge and innovation (chapter 3) are based on a better understanding of the user behaviour in the urban environment (chapter 4).

1. Integrating the urban mobility system

Often, the most efficient solutions at the urban level will be multimodal, involving several modes of transport. They would also require an optimised multimodal management of the urban mobility system, not a segmented management of the modes of transport. The current lack of integration is often damaging for the overall efficiency of the system. It is therefore necessary, to provide for this more efficient mobility, to integrate the system, ensuring the provision of integrated multimodal options, as smooth as possible transitions between modes, and integrated tools such as integrated information across modes.

Integrating the urban mobility system is key for a sustainable development when focusing on end users benefit and on general interest.

1.1 *The integration of urban traffic and travel information*

An integrated urban mobility system should be a system where information on all modes of transport is available to users, transport operators and network managers, and updated as required to make optimal decision³.

The first objective is the provision of comprehensive information to the travellers about all his or her mobility options on the urban environment for the trip he or she wants to do or has started. It therefore covers *pre-trip* as well as *on trip* information, including route planning services: integrated information should include route planning services.

This information must bring together road traffic information, information on walking, cycling, public transport (in its various components, including shared private modes and co-modality), parking, traffic regulation (including access control), prices and charges for mobility services and infrastructure use if and when applicable. It should also progressively integrate information about accessibility and externalities.

With the deployment of electromobility (see also clause 3.1 and 3.2 below), information of relevance for the use of electric vehicles should also be considered. It would include the location of publicly available charging points, the type of charging points, and services related to electromobility such as for instance electric car sharing vehicles or public electric vehicles.

The provision of integrated information can also be **a tool for the network manager** to influence travel behaviours, through information provided with route planning.

² ERTRAC Strategic Research Agenda sets the objectives of an urban mobility system which would be 80% more energy efficient by 2030, measured in energy per passenger km.

³ The ITS (ITS: Intelligent Transport Systems) directive terminology is the reference for the parts of this roadmap relevant for ITS (ITS Directive 2010/40/EU on the framework for the deployment of Intelligent Transport Systems in the field of road transport and for interfaces with other modes of transport)

The provision of information therefore includes several components among which:

- the provision of transport data,
- the integration of data on urban transport and mobility,
- route planning advice, recommendations or incentives.

In the later case, and if integrated traffic and travel information is provided or influenced by a local public authority acting at the level of the urban area, it becomes a network management tool.

The requirement regarding **the provision and availability of data**, and the various types of actors likely to use this data to provide information, private or public, local, national or multinational, should be carefully considered for the achievement of appropriate research actions.

The development of digital maps with updated and accurate transport network attributes, the development of traffic and transport databases or transport data market places, and progresses towards some forms of certification of data quality are all essential to achieve integrated urban traffic and travel information.

They are dealt with at the European and national levels, for instance in the framework of the European directive on ITS.

It should also be stressed that the **governance** supporting data collection and the release of data enabling the provision of integrated traffic and travel information is very important. The cooperation between actors, the role of public authorities, their choice for the release of data to the public and private information providers, ownership of data, and the European and national regulatory framework, all condition the terms of the provision of integrated traffic and travel information. The increasing provision of open data on transport contributes to further develop new governance models.

Beyond information on the urban mobility system, the **development of a travel planner at EU scale** is also a priority to allow transport users to be better informed on transport options from origin to destination across Europe.

Milestone 2015	Milestones 2020	Milestones 2025
Integration of traffic and travel information and all mobility related information at the urban level, relying on qualified data	Integration of traffic and travel information and all mobility related information, relying on certified quality of data	
	Full integration of externalities with the information: environmental data, risk, etc.	
	Systematic integration of information about all mobility services, including information related to electromobility	
	Integration of information on all urban networks of large and medium size	Integration of information on all urban networks of all sizes

Table 1: Integration of urban traffic and travel information - milestones

The availability of information should be guaranteed to all potential users, without discrimination between users. This requires that the communication infrastructure in the urban environment has the capacity to accommodate the request for information of all users. Bandwidth and communication tariffs should therefore for instance not create restriction on the access to information, for certain type of users, such as for instance foreign visitors. This is also essential for the integration of payment and ticketing systems.

Roadmap	2011	2015	2020	2025	2030
Integration of traffic and travel information					
Definition of data quality					
Integration of information on all types of externalities					
Integration of information on electromobility					
Open interface and data enabling for the integration of the information					
Governance models enabling the integration of traffic and travel information					
Security and privacy framework for the provision of transport data and information					



Table 2: Integration of urban traffic and travel information - roadmap

1.2 The integration of ticketing and charging services for all mobility related charges in the urban areas

The roadmap identifies research needed for developing systems and models reaching the optimum level of integration for ticketing and payment systems for all mobility related charges.

Mobility related charges can include public transport fares, parking, mobility services such as public bikes, congestion and infrastructure charges, etc. Considering that a key challenge consists in integrating public transport ticketing systems locally and that the number of transactions for public transport is by far the greatest of all payment of mobility services, public transport is driving this integration of ticketing and charging services.

Two parallel streams have to be pursued at the moment. The first one consists in the progressive development of an interoperable contactless based ticketing and fare management system following the recommendations of the EU-IFM project⁴. It should lead to the deployment of a common application for the payment of mobility services across Europe which can be used on various media through the development of an EU IFM Alliance⁵.

⁴ <http://www.ifm-project.eu/>

⁵ A Memorandum of Understanding (MoU) about the creation of an EU IFM Alliance has been signed in February 2012 - at the IT-TRANS conference organised by UITP and KMK (Karlsruher Messe - und Kongress GmbH) - by

The second stream foresees the integration of the payment of urban mobility services via credit/debit card payment systems used with contactless payment systems.

On the mid-term, these two streams could lead to complementary solutions, applied progressively over a larger number of cities and regions of Europe (and outside Europe).

Milestone 2015	Milestones 2020	Milestones 2025
Interoperable common multi-application processes on a single media	Extension of the EU IFM Alliance	Creation of a common EU-IFM application which can be uploaded on several media
Common European portal	Common European portal and common template for products	
Integration of local Public Transport services and some other mobility services	Extension of integration of local Public Transport services and other mobility services (information and payment)	Extension of the integration of all mobility services
Integration of the payment of urban mobility services via credit/debit card payment systems used with contact less payment systems (some cities/some services)	Extension of the integration	Extension of the integration

Table 3: Integration of ticketing and charging services - milestones

This figure 1 below illustrates the main principle of the roadmap proposed by the IFM project for the long term development of Interoperable Fare management across the EU.

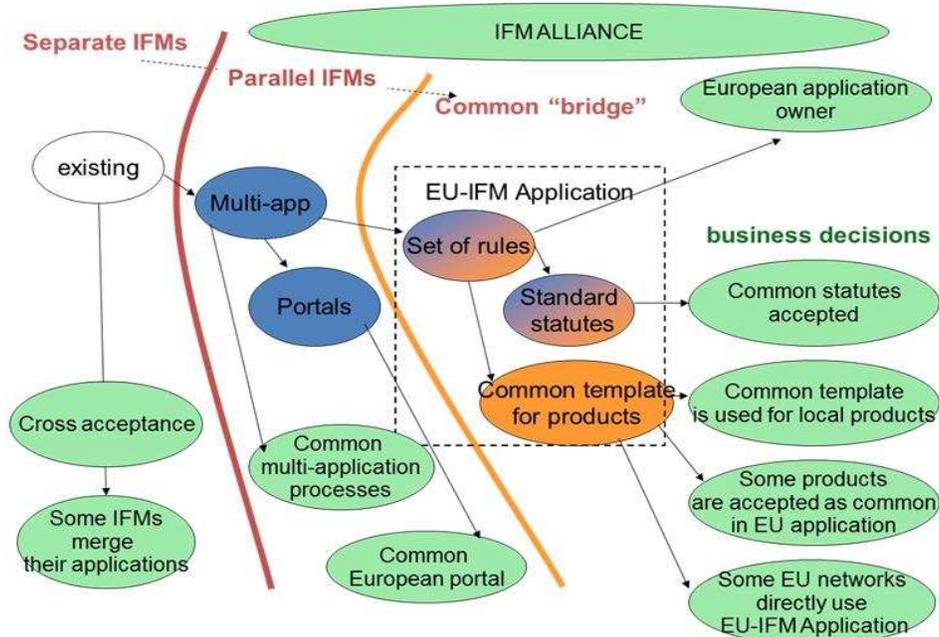


Figure 1: IFM project Roadmap (Source: D. 7.3 Final deliverable)

representatives of the organisations for technical specifications of VDV KA (Germany), ITSO (UK), AFIMB (France) and Calypso Network Association together with representatives of UITP. The MoU presents a platform for cooperation in the context of today's infrastructures and systems and a way forward to establish a European Alliance for developing European interoperability of contactless ticketing systems. See: <http://www.uitp.org/news/pics/pdf/IFM%20MoU%20pressrelease%2016%20feb%20ver%202.pdf>

This part of the roadmap covers the integration of the various payment tools but also of the related pricing and charging policies, such as parking, infrastructure charges, public transport fares, eco-pass and congestion charges, new mobility services, etc.

It therefore also covers the research on the definition of pricing and charging of mobility services in the urban environment. Research in this respect covers several issues such as the level of charges, regulatory, financing and business models for mobility services and transport infrastructure from a global urban area perspective. The definition of these policies, which is strongly related to the analysis of the user's response to charges signals, should consider their impact on the overall policy objectives. It is also related to the previous clause of the roadmap on integrated traffic and travel information as information about charges and prices for mobility services must be a part of an integrating route planning information.

Roadmap	2011	2015	2020	2025	2030
Creation and extension of an EU-IFM Alliance		[Blue arrow from 2011 to 2025]			
Update and harmonise if needed current CEN Standards to support EU-IFM		[Green arrow from 2011 to 2015]			
Interoperability for customers through common multi-application processes on a single media: create a Pilot operation in a number of Member States in preparation for wider roll-out		[Yellow arrow from 2011 to 2015]			
		[Pink arrow from 2011 to 2015]	[Blue arrow from 2015 to 2020]		
Develop a Common EU portal and Common Product Templates supporting an extension of the "IFM Brand"		[Yellow arrow from 2011 to 2015]			
		[Pink arrow from 2011 to 2015]	[Blue arrow from 2015 to 2020]		
Create a common EU-IFM application		[Yellow arrow from 2011 to 2015]	[Pink arrow from 2015 to 2020]		
Develop a commercial and technical framework for the sales and settlement of EU-IFM Products		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]	[Blue arrow from 2020 to 2025]	
Extend functionalities to facilitate inter-modality and Demand Management		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]	[Blue arrow from 2020 to 2025]	
Engage and merge with existing IFM Systems and other ITS services and transport modes		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]	[Blue arrow from 2020 to 2025]	
Engage with applications for electromobility related services		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]	[Blue arrow from 2020 to 2025]	
Security and privacy framework for contactless payment		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]		
(New) charging and pricing policies strategies		[Yellow arrow from 2011 to 2015]			
			[Pink arrow from 2015 to 2020]	[Blue arrow from 2020 to 2025]	



Table 4: Integration of ticketing and charging services – roadmap

1.3 Interchanges for passenger travel and transport

Interchanges allow for the physical integration of the various modes and networks and for a convenient transfer of travellers from one mode to another: research should focus at making interchanges enabling as smooth a transition between modes as possible. Their function in the urban mobility network should be enlarged and their role in the urban environment further researched.

Milestone 2015	Milestones 2020	Milestones 2025
Interchanges as the hubs of the urban mobility network facilitating the transition between all modes of transport, offering several transport services	Integrating interchanges in the smart cities	

Table 5: Interchanges for passenger travel and transport - milestones

They should integrate all modes of transport and go beyond the integration of major modes, such as rail public transport and road public transport.

They should foresee the integration of new mobility services, of cycling, of parking, etc. Integration with walking should be an integral part of the interchange design and conception.

They should also take into account new opportunities of modal combinations (passenger and freight), including for energy supply to transport and new technologies of information and communication (see clause 3.2 below).

Transport interchanges should become the future hubs of the smart cities, integrated not only in the transport network but in their urban environment and the other smart networks, in particular the smart electricity grids. They should themselves, as infrastructure, contribute to the increase of the energy efficiency of the city.

As key component of the transport network and of the urban environment, the planning for interchanges should be coordinated with local land use strategies. The identification of the best location of interchanges for the city and the efficiency of the transport network should be part of the research activity covered by this roadmap.

Roadmap	2011	2015	2020	2025	2030
Design and operation of new generation of urban transport interchanges for greater integration of urban mobility networks					
Financing and business models					
Integrating interchanges with urban policies (Land use planning, economic development, etc.)					
Building resilient interchanges					
Integrating interchanges, nodes of the smart city					



Table 6: Interchanges for passenger travel and transport – milestones

1.4 New city logistics concepts and interfaces for a more efficient freight delivery

Urban freight delivery suffers from the lack of coordination of the actors whereas they share to a large extent the same objective of an efficient system for the delivery of goods in the city. It also lacks financially sustainable options and broad stakeholders support for reorganising city logistics.

The main stakeholders (public authorities, freight operators, retailers, infrastructure managers) lack the appropriate framework and tools to exchange information and adjust accordingly their transport plans.

It is therefore necessary to develop an interface allowing for the integration of the information of relevance for urban freight delivery and facilitating the exchange of the relevant information between the public actors, in particular the public authorities regulating and managing the road network, and the private actors. This will enable new delivery concepts and services.

Milestone 2015	Milestones 2020	Milestones 2025
Deployment of a an information exchange platform for urban freight delivery stakeholders. Provision of data of relevance for urban freight.	Integration of e-Freight in this platform to extend some of its features to the urban environment	

Table 7: New city logistics concepts and platforms for a more efficient freight delivery - milestones

This platforms should include all information related to traffic regulation, parking and access related to urban freight delivery. It could also be used for freight consolidation, the management of urban distribution centers and logistics platform, and for the use of electric vehicles for urban freight delivery. It could enable the other stakeholders to upload non commercially sensitive information for the optimisation of the rules and recommendations for freight delivery. It would lead to useful route planning recommendations and incentives.

The deployment of eFreight could create further opportunities for managing urban freight delivery. Several features of eFreight could be extended to the urban environment in a second stage.

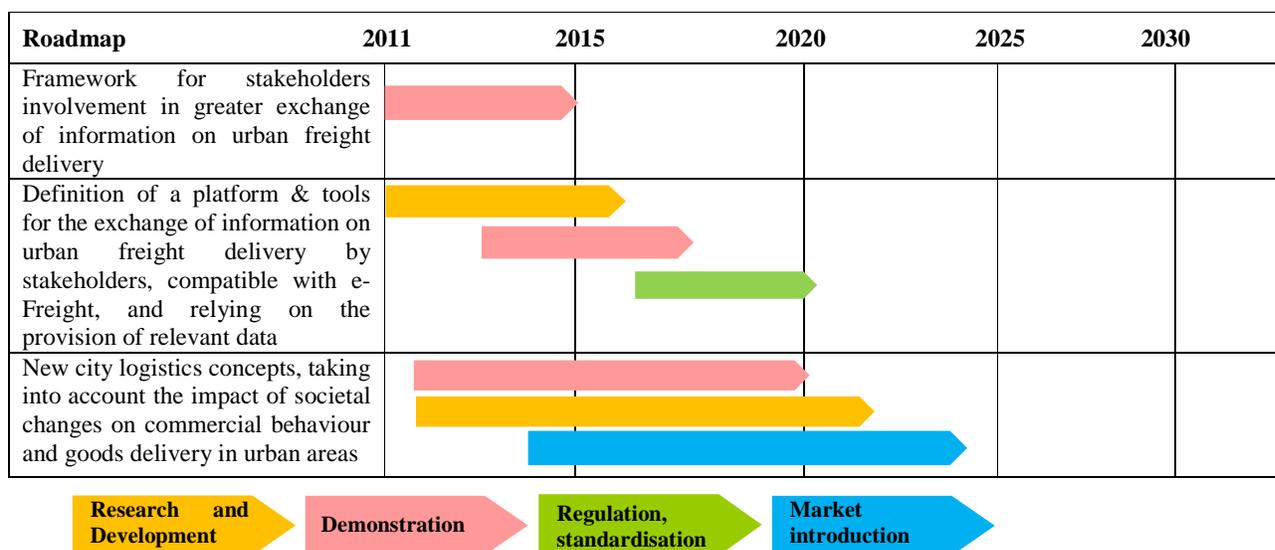


Table 8: New city logistics concepts and interfaces for a more efficient freight delivery - roadmap

1.5 Integrating urban mobility management

The management of the urban mobility networks currently involves a broad range of tools. These include public transport management, traffic management, at intersections and through the control centre and the use of various incentives and regulations, including parking policies, traffic regulations, access rules and regulations such as the reservation of road space for dedicated purposes (bus or light rail lane, bicycle path, pedestrian area...), and in some cases access charges. Those can be considered as demand management tools.

Mobility management also includes the provision of various mobility choices in the urban environment covering a wide range of public transport services (a large variety over city areas and periods of the day), walking and cycling paths, and the development of complementary types of mobility services such as car sharing or public vehicles.

Traffic and travel information offering travel planning and recommendations, both pre-trip and during the trip, are another type of network management tool (see above clause 2.1). When these are provided by the public authorities, they can be direct tools for network management. They include for instance the management of urban public transport services in case of incidents, taking into account connected social networks of customers reacting on real-time and location based.

New information providers consolidating various types of data are emerging - providing information about the various tools mentioned above.

The segmentation of the various tools, in particular public transport and traffic, has to be overtaken to achieve a real integrated network management in real time.

The increase of the amount of data collected on the network through cooperative systems, mobile phones, and other data sources, increases the potential for network management. The integration of these various tools conditions its optimization.

As it would bring together data from private and public transport, and from individual and collective modes of transport, it should allow better knowing and better managing the movement of *persons* and not only of *vehicles*.

For this purpose, network management should progressively take into account a broader range of policies (demand management – space allocation, parking management, charging policies, speed limits) and all mobility options, including cycling and walking.

An important number of research activities are required to achieve this objective of an integrated network management.

Milestone 2015	Milestones 2020	Milestones 2025
Integration of network management tools, based on vehicles and individuals data	Integrated network management optimizing individual accessibility and urban mobility network efficiency	

Table 9: Integrating urban mobility management – milestones

Roadmap	2011	2015	2020	2025	2030
Network management strategies, integrated with sustainable urban mobility plans					
Governance for the coordination of the network management tools					
Interaction between private cooperative network management and public network managers					
Algorithms for network management					
Short term forecasting models					
New intelligent decision support systems for network management					
Strategies and models to face serious network disruption, network management for climate resilience					
Optimization of PT operations through network (including traffic) management tools					
Evaluation of models efficiency and network management tools and policies					
Integration of freight movement in network management					
Integration of a all modes and mobility options, and of a greater variety of network management tools, in network management systems					



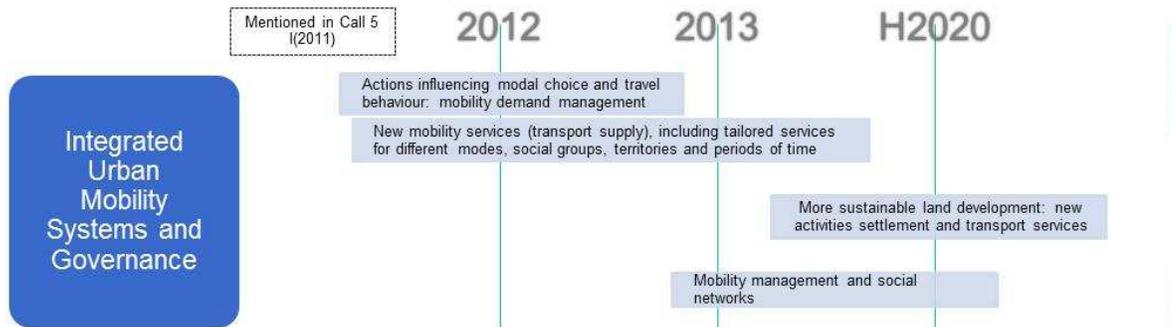
Table 10: Integrating urban mobility management – roadmap

2. Developing services and infrastructure for the long term efficiency of the urban mobility system

In parallel to the integration of the urban mobility networks, research efforts should also be geared towards the development and provision of new mobility services and adequate transport infrastructure. They should cover both short term research actions targeting short term effects, and long lasting research actions starting now supporting policy decisions with long term effects (driving interaction between land use and transport).

2.1 New mobility services

Research on **new mobility services** (transport supply) should address tailored services (see also 3.2 below), and the provision of **location-based urban services** in addition to the core public transport supply. These include parking, collective and private transport.



2.2 Infrastructure

Building new infrastructure in urban areas is necessary to face the expected growth of mobility needs, especially on public transport, while facing new constraints:

- public resources are increasingly restricted both for investment and operations;
- environmental concerns are everyday more stringent;
- legal processes are more and more time consuming.

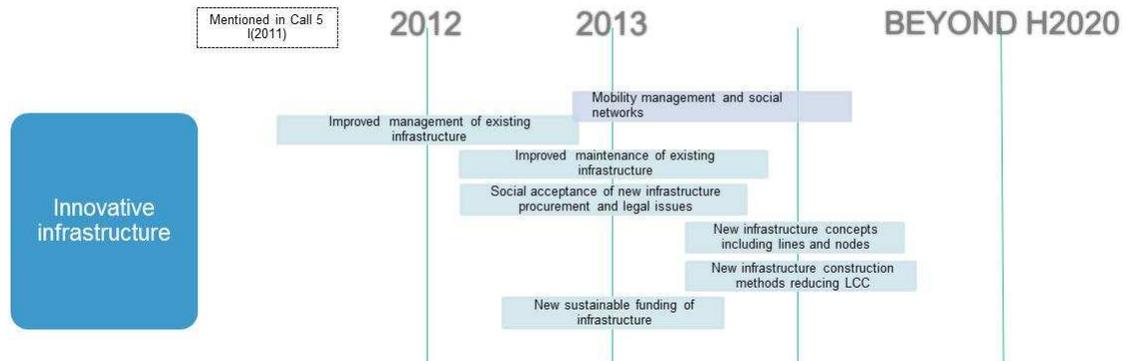
Research priorities are covering technical, social/societal and financial issues:

- **New infrastructure concepts reducing Life Cycle Costs &** covering improved design, faster and cheaper construction and easier operations and maintenance (“intelligent infrastructure”);
- Research on **social/societal acceptance of new infrastructure**.
- New **sustainable funding methods**.
- **Joint approaches for the robustness and resilience of urban transport systems** (facing and recovering from incidents, accidents or disasters).

It should be noted that existing or new **electric** public transport infrastructure has a potential to serve as a backbone of a future multimodal electric urban transport infrastructure combining rail public transport and other electric modes – buses, car, taxis, bikes...- used either on a private or shared basis: indeed the power sub-stations required for the operations of tram, light rail and metro (or trolleybus) can be located in places next to stops and stations where electric vehicles could charge their batteries while the driver or passenger continues his trip by using public transport (“Electropark and ride” or “Electrokiss and ride”). This could lead to new multimodal mobility business models for private users, public transport operators or energy providers.

A roadmap on **land use and transport** will be developed by ERTRAC in cooperation with ERRAC. It considers among others the following research topics which are of prime importance for urban transport infrastructure:

- How to **integrate land use, transport and environment policies** in a coherent way over time at these various levels, with a view to tackle the global challenges?
- Research on **integrated land use, transportation and mobility planning and management**, covering short term or long term targets and taking into account the interaction between new activities settlements and transport services.
- **Defining accessibility concepts** as a tool for measuring impact of urban land use and transport policies, and as objectives for the development of new transport services.



3. Supporting knowledge & innovation

The deployment of innovative solutions for a more sustainable and efficient urban mobility system remains too limited. Several barriers should be considered to overcome this situation. They should constantly be addressed by European research efforts. This situation could be dealt with through several initiatives targeting the relevant actors, such as:

- **developing the appropriate skills and training tools and programs;**
- **improving the awareness and facilitating the understanding** of sustainable mobility challenges and solutions.

3.1 Improving knowledge with data collection and analysis

The lack of data on urban mobility is another barrier, preventing sometime the transfer of efficient solutions, but also a better understanding of urban mobility challenges.

It is necessary to pursue efforts for the collection and sharing of data on urban mobility to support research and decision making.

A horizontal **priority** along all major research components is the need for **consistent data collection and exchange on urban mobility** and the **development and use of harmonised models** supporting data analysis, land use and transport forecasts, cost-benefit and multi-criteria economic analysis and decision-making.

3.2 Strengthening the cooperation between stakeholders

Cooperation between stakeholders is a necessary condition for the success of any sustainable urban mobility policy over time. Research topics in this area are numerous and strategic:

- How to **improve awareness and facilitate understanding** of sustainable mobility challenges and solutions by relevant stakeholders at various institutional levels depending on the territorial point of view (city, region, country, whole Europe)?
- **Which standardisation** – going beyond benchmarking – in a global competing economy?
- How to **develop jointly the robustness and resilience of urban transport systems** (facing and recovering from incidents, accidents or disasters)?
- How to **develop the appropriate skills and training tools and programs** for the transport industry (manufacturers and operators) and policy makers?



4. Understanding better the user behavior in the urban environment

ERTRAC and ERRAC have both developed a roadmap addressing user needs and user behaviour per category of users. It is however useful in this joint roadmap to list all the topics related to the understanding of user behaviour which can be exploited to improve the efficiency of the urban mobility system. Offering attractive and competitive transport services calls for a better knowledge of citizens' expectations and possible reactions to innovative mobility measures and services. A large variety of socio-economic studies have to be developed.

These studies, depending on their scope, may focus or not on specific categories of users, depending on the one hand on their household and individual characteristics (pupils, students, workers, active population, women with children, unemployed, retired people, old people, persons with reduced mobility, car ownership level...) and on the other hand on their level of accessibility to the different transport means (motorised or not, public or private) and to the various urban activities (such as dwelling, education and training, working, shopping, leisure, culture) depending on their location (central areas, remote suburbs and so on).

The scope of research on user behaviour should embrace the following topics:

Traffic and travel information

- User response to traffic and travel information, in particular to:

- intermodal traffic and travel information;
- technology used for the provision of information;
- environmental information related to trips;
- weather information related to trips;
- various degree of reliability of information;
- road safety risk information;
- Individual privacy concern, protection of individual rights, and ethical issues related to mobility information and services

Integrated charging and payment systems

- For **integrated charging and payment systems**, user response to price signals:
 - Public Transport fares
 - Parking fares
 - Congestion charges
 - Infrastructure charges
 - Infringement fines and penalties
 - Innovative mobility services prices
- User response to technologies used for the payment of mobility services
- Individual privacy concern, protection of individual rights, and ethical issues related to integrated payment systems
- Relative user preference for integrated payments through integrated ticketing or credit card systems

Integrated network management

- User response to network management tools such as access restriction, speed management, trip length and time
- How to **translate user expectations into functional requirements** for adapting services or developing new ones - without negative impact on privacy and individual rights? How to measure the impacts on the level of demand for passenger transport?
- Social/societal acceptance of new infrastructure and citizen participation in the planning process



