



Recommendations to plan and implement

# **URBAN ITS SERVICES**

Transferability Handbook



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Recommendations to plan and implement

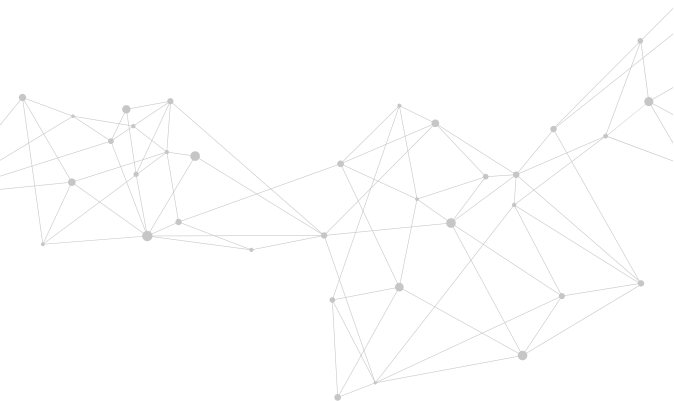
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# FOREWORD



**OPTICITIES** is a three-years innovation project implemented between 2013 and 2016. It gathered European cities, companies and research institutes to develop and experiment innovative Intelligent Transport System (ITS) solutions to foster efficient and sustainable urban mobility.

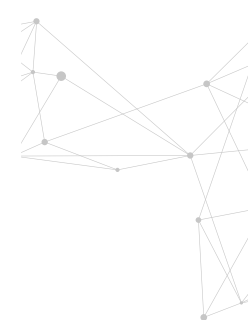
**OPTICITIES** addressed the whole information value chain on mobility: from data collection to processing up to services' delivery towards final users including network operators, citizens and freight operators. One of the project's singularities was based on the cooperation of operators and innovators looking jointly forward to scale up solutions aimed at being implemented and commercialised in a three years horizon.

**OPTICITIES** results are impressive! They include operational tools and solutions, some of them already supporting network exploitation, providing concrete answers to urban mobility stakes. They also include prospective developments designed to address tomorrow's challenges in terms of urban mobility at European scale. All approaches have been conducted including the idea of challenging the economical framework and supporting large-scale replications.

This Transferability Handbook has been elaborated as a toolbox targeting cities and service providers looking for references, concrete experiences and contacts. It presents a digest of OPTICITIES key results.

Detailed information is compiled in a set of Deployment Guidelines available online on the OPTICITIES Stakeholder Forum [ [www.opticities.com/stakeholder-forum/online-forum](http://www.opticities.com/stakeholder-forum/online-forum) ].

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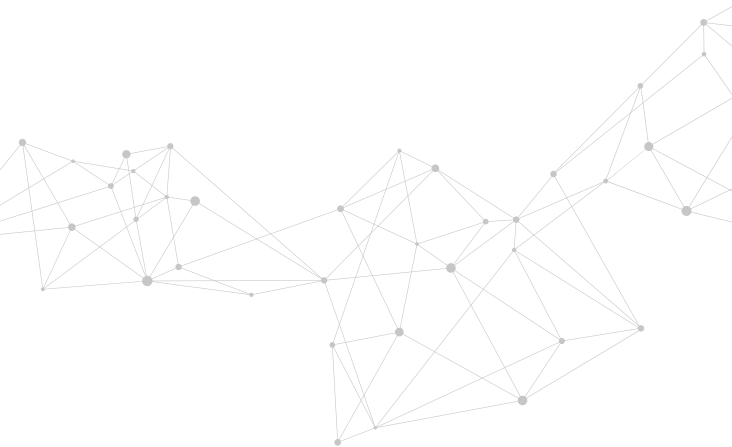




## GLOSSARY

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<b>ADR</b>	Automatic Detection and Reading
<b>ANPR</b>	Automatic Number Plate Recognition
<b>API</b>	Application Programming Interface
<b>CEN</b>	European norm from the European Committee for Standardization
<b>GTFS</b>	General Transit Feed Specification
<b>MDCS</b>	Multimodal Data Collector System
<b>MDS</b>	Mobility Dataset
<b>MMIS</b>	Multimodal Information Services
<b>PT</b>	Public Transport
<b>PTA</b>	Public Transport Authority
<b>PTN</b>	Public Transport Network
<b>PTO</b>	Public Transport Operator
<b>SAE</b>	Exploitation System
<b>SUMP</b>	Sustainable Urban Mobility Plan
<b>TMC</b>	Traffic Management Centre
<b>UX</b>	User Experience
<b>WFS</b>	Web Feature System
<b>WMS</b>	Warehouse Management System



# HANDBOOK APPROACH

**T**his handbook has been elaborated with the objective to gather the key learning points and success factors of the project in a user-friendly format. It aims at enhancing the take-up process of OPTICITIES results.

This document synthesises the recommendations for implementation elaborated in 17 Deployment Guidelines. As such this handbook constitutes a digest of these technical deliverables.

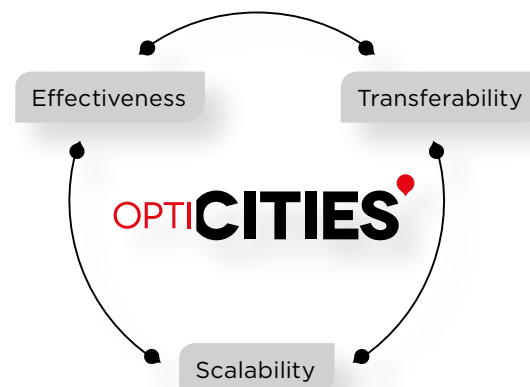
One will globally embrace the outcomes of OPTICITIES project within this document. Extensive contents are available on the Stakeholder Forum.

## Online Stakeholder Forum

The OPTICITIES Stakeholder Forum gathers stakeholders from both the ITS community and local authorities to ensure a durable link during and beyond the course of the project. Its aim is to support and enable the replication of OPTICITIES outputs on a European scale:

- **Engage** cities, public transport authorities, companies and interested parties in exchanging information and experiences with project partners
- **Share** strategic results and public deliverables with the extended ITS community
- **Accelerate** the mass deployment of OPTICITIES outcomes.

## THE 3 PILLARS OF GUIDELINES ELABORATION



## OPTICITIES DEPLOYMENT GUIDELINES ARE AVAILABLE!

A comprehensive repository of complete recommendations for implementation is available online for interested stakeholders, tackling the topics addressed in this handbook.

Consult the full set of Deployment Guidelines:

<http://www.opticities.com/stakeholder-forum/online-forum>

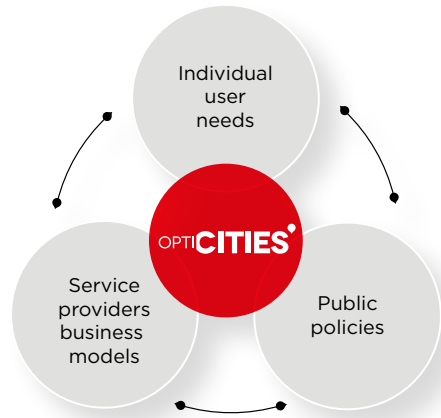




# OPTICITIES PROJECT

**Public and private stakeholders  
associate to elaborate  
the future of mobility services**

OPTICITIES develops a vision of optimised urban mobility at the focal point of user needs, urban mobility public policy, and business models of service providers.



## The key assets of this approach are:

- A geographical and modal urban mobility data completeness thus reinforcing public service quality
- Deploying truly multimodal services, supporting the diversity of service offer, sustaining high value services
- Ensuring coherence between user-oriented services and urban mobility public policies.

**6%**  
Modal shift

**1.5**  
million tonnes  
of CO<sub>2</sub> saved/year

**3 years**  
2013-2016

**25**  
partners

- 6 cities
- industries and service providers
- academics
- experts and networks involved in urban Intelligent Transport Systems



**13M€**  
budget

- Supported by a 9M€ funding envelope allocated by the European Commission through the FP7 framework programme

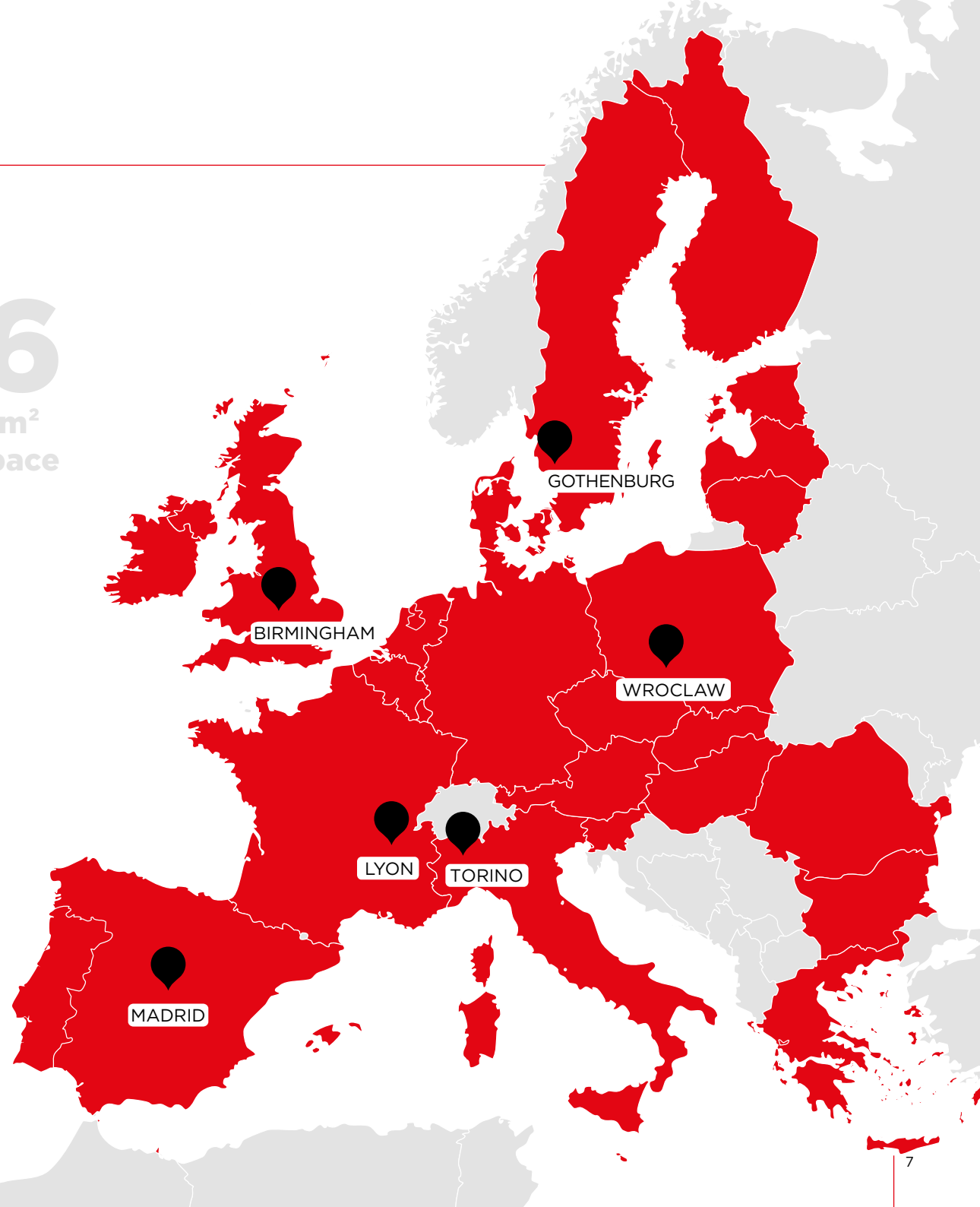
**3.6**  
million m<sup>2</sup>  
public space  
gain

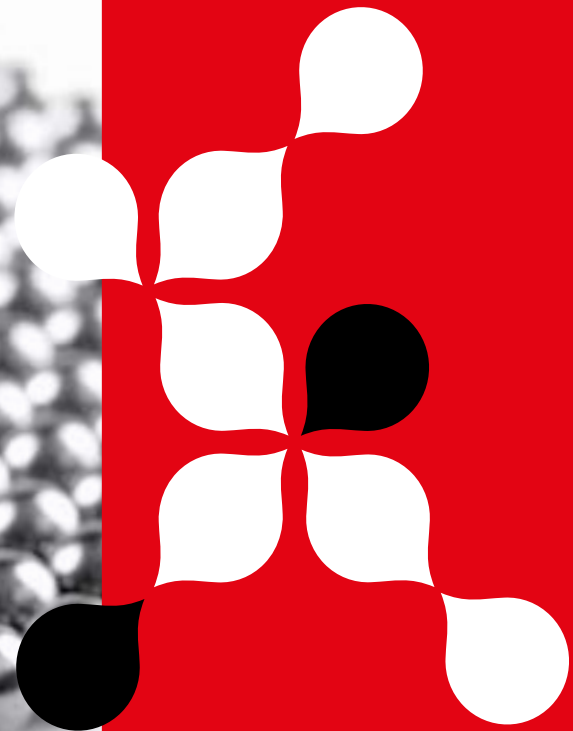
## 4 Experimentation fields

- Urban data creation and use
- Decision support tools for network managers
- Traveller information services
- Freight information services.

## Impacts and benefits

- Modal shift: **6% towards soft and public modes** by 2020
- Public space management: **gain of 3.6 million m<sup>2</sup> public space**
- Traffic congestion decrease and optimised road network operations: reduction of **1.5 million tonnes of CO<sub>2</sub>** per year
- Promotion of a European ITS market for urban mobility thanks to interoperable solutions
- Optimisation of urban freight operations.







# DATA CREATION AND USE

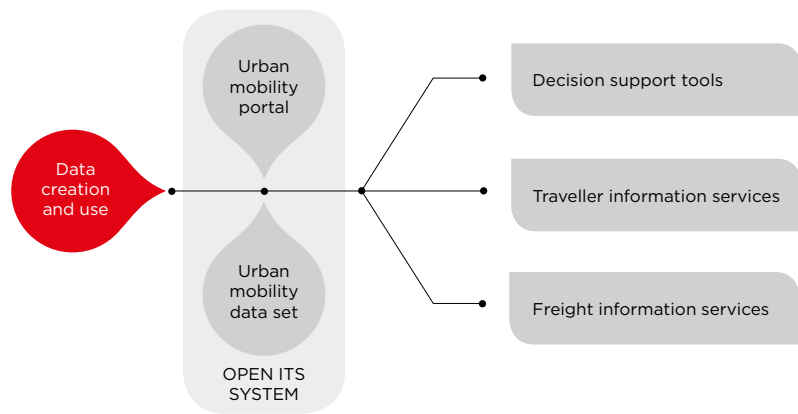
## [ OBJECTIVES ]

- Develop innovative data monitoring systems related to passenger mobility and freight
- Gather data from numerous public transport operators in large cities, and combine them with other mobility data
- Improve monitoring of road works
- Improve monitoring of freight data
- Increase data collection through the use of users experience

**MULTIMODAL  
DATA INTEGRATION  
IN LARGE CITIES**

**ROAD WORKS DATA  
COLLECTION**

**NEW TOOLS FOR  
FREIGHT DATA  
MONITORING**



# MULTIMODAL DATA INTEGRATION IN LARGE CITIES

## FOCUS AND OBJECTIVES

In metropolitan European areas, the sources of transport-related data, as well as the number of actors involved in different transport services, are high, with a wide range of backgrounds and conditions.

At the same time, competences in mobility are shared among numerous entities and a comprehensive overview is hard to reach because of a lack of a real common language clearly defined and coordinated. Thus the challenge consists in consolidating a big amount of information coming from legacy capacities and delivered, in some cases, by proprietary systems and formats. Madrid region is an example of how data on various traffic modes and information flows are fragmented.

The objective is to integrate multimodal data from public and private transport operators as well as other mobility data from different sources in a unique platform that allows a common use of the information, as well as sharing of data with third parties' usage.

## Situation and challenges

The transport system in the Madrid Region counts over 40 public and private operators with a wide range of transport services, information and infrastructure where Consorcio Regional de Transportes de Madrid (CRTM), as the public transport authority of the region, is in charge of its coordination and the establishment of the conditions under which services must be provided to clients.

Main challenges are:

- Aggregation of information from different sources in the same platform in a common and structured format:
  - Public transport information of more than 40 operators including more than 10.000 cameras and the real-time location of more than 5.000 vehicles and 6.000 variable information signs
  - Information from other sources such as Madrid City Council, road or emergency services.
- Provide all this information to third parties in a harmonized format to be easily integrated and utilized
- Provide multimodal and accurate information to public transport clients through different channels.

## Approach

The main goal was to develop a centralized system that obtains information related to the Public Transport Network (PTN) of Madrid region (Madrid City, metropolitan and sub-urban areas) from different Public Transport Operators (PTOs) and other entities. It is able to manage and aggregate all this information in a comprehensive picture, in order to help CITRAM operators to make decisions based on this compiled information. CITRAM being Madrid's PT Operation Control Centre (OCC).

Thanks to the Service Oriented Architecture (SOA), on which the solution is based, scalability and interoperability is ensured, facilitating the option of considering new data sources for the system by developing the integration needed between the new system and the multimodal data collection system. In the same way, new applications could utilize the information provided by the system thanks to its homogenized formatting, independently of the PTO that provides the information.

## Results

CRTM has developed the Multimodal Data Collector System (MDCS), which is composed of a set of web services. They collect data from circa 45 sources through their own SAE or other mechanisms, such as proprietary files (XML, KML) or incident management system (GEIS). CRTM makes this data available to PTOs through its Operation Control Centre (OCC) CITRAM. This information is received and processed in order to provide the information in a unified format to different applications, which exploit this data for their own purpose.

Two main groups of methods and several categories have been developed:

- Collecting information from different PTOs: the sub-module "WS MultiSAE" in charge of the data collection collects the information from the own PTOs SAEs and static information knowledge database
- Providing the collected information in a unified format: the sub-module "WS SAE Multimodal" in charge of provisioning the collected information provides it in a unified format, making it available to users and/or different applications, which could exploit it.



#### More information

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Both real-time and static information are provided in unified format to other applications such as Decision and Orchestration Engine (DOE), Passenger Information Management System (SGiP), Journey Assistant (JA), amongst other CRTM tools.

### Lessons learnt

#### Policy issues

Establishing an agreement when the number of stakeholders and data sources are considerable and of different origin (public/private) is rather complex. Objectives and implication may be different.

#### Technical issues

- It is important to know what will be the final use of the retrieved information, as some cache system will need to be used if the data demand may be considerably simultaneous
- Information mapping from each data source towards the homogenised format has required a bigger effort than expected.

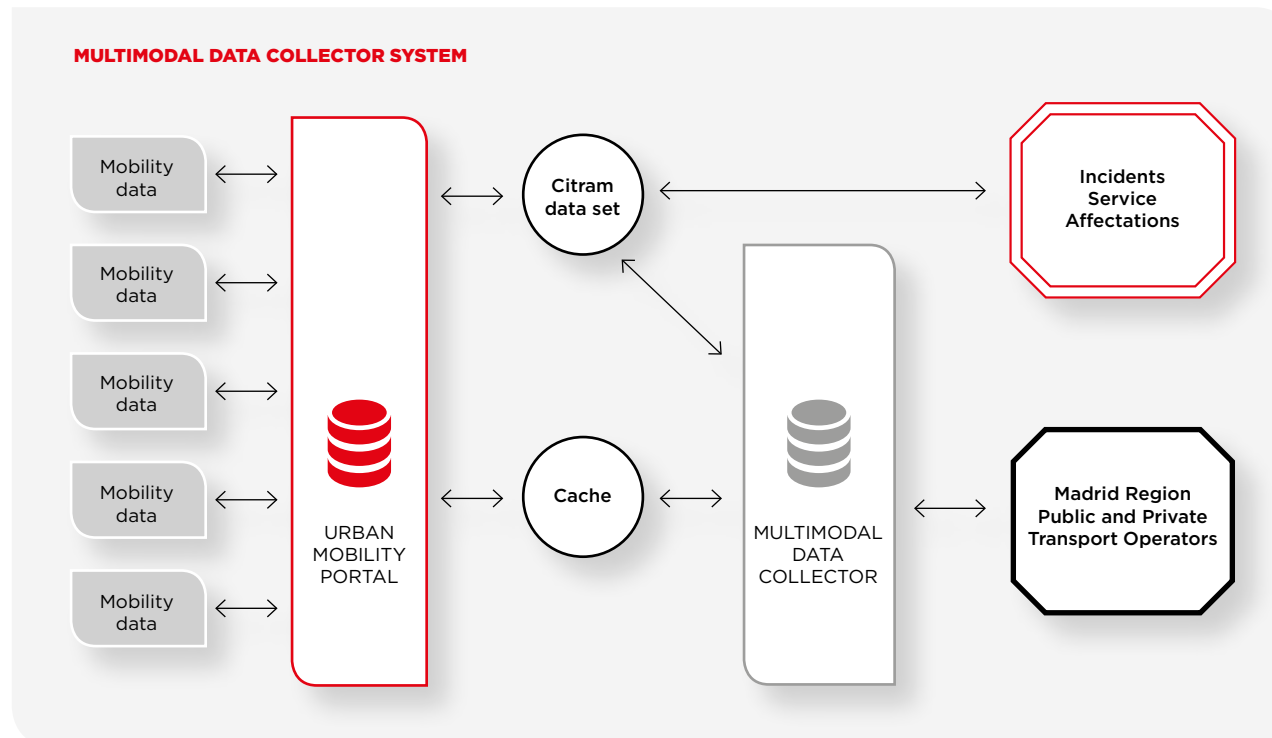
#### Organisational issues

The implication of public transport operators in this process, as well as the close collaboration between different stakeholders responsible of this development has been decisive.

#### Legal issues

Contracts have been signed related to data collection:

- Contracts with public transport operators in order to integrate all the systems of the suburban companies in CITRAM with the functional specifications provided by CRTM
- Application of the Spanish personal data protection law on all the ethical matters faced during the development of the Multimodal Data Collection System
- Agreements of collaboration and cooperation with external organisations and institutions.



#### REPLICATION POTENTIAL

  
Easiness of replication

  
Impact on mobility

# ROAD WORKS DATA COLLECTION

## FOCUS AND OBJECTIVES

To provide good traffic information to road users you need to have top notch road works information.

As well as informing stakeholder adequately about each roadwork, the city needs to synchronize all active work in the nearby areas to limit lock-outs and also to allow businesses and residents to see who is doing what and when.



## Situation and challenges

The major challenges to access top notch road works information are the following:

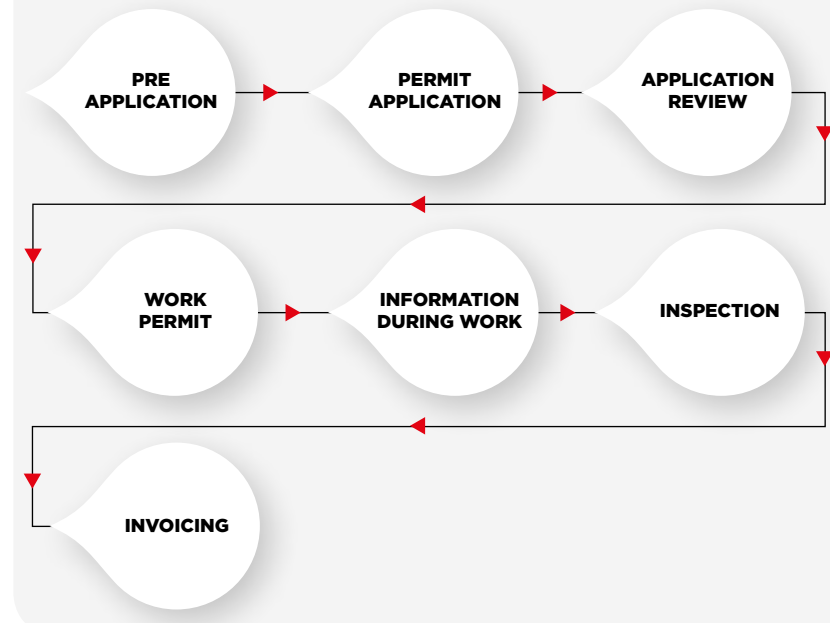
- Contractors are focused on getting the job done, rarely to inform how traffic will be affected
- A road work permit is normally valid over several days but there is usually little or no way of knowing when the contractor is actually working
- Lack of synchronisation between road works may cause unforeseen adverse traffic restrictions, such as lock-outs from specific areas
- Information is needed not only for roads but also for bike lanes and pavements
- On top of last mile the 'last few meters' can be overlooked for goods.

## Approach

During the project we have not only developed this tool but also the processes to utilize the tool within the organisation. In order to provide top notch information about roads works we decided to go to the root of the problem, how road work permits are issued and handled. In this way we can assure that information is provided to end users as well as that the information is always up to date.

We decided that we would send the information about road works on to the regional Traffic Control Centre who could in turn issue this information through their existing channels e.g. Car Navigators (TMC) as well as travel planners through open data (DATEX II). This would create a comprehensive picture of both the state and city owned roads. To conclude, the scope of this project has been a new permit system to harvest all information about road works, coordinate and making sure that traffic information about relevant road works are issued via DATEX II.

### MAIN PROCESS OF ROAD WORKS PERMIT APPLICATIONS



## Results

The urban transport authority of Gothenburg has developed a tool for the administration of roadwork permits called “NyStart 2.0”. The tool is not only used by the administrators of the permits but also by companies and contractors who perform the road works.

Main purpose is to handle applications for permits for work carried out on or near the roads. The application for permit includes information such as when and where, who shall do the

work, how traffic will be managed during active work and what type of work it is.

Companies are added to the company registry and users are connected to each company. One or more users can be defined as administrators for a company. The agreement defines the contractual relationship with the public authority and if the construction company is liable for future maintenance costs or not, and if work carried out requires inspection.

## Lessons learnt

### City’s policy in question

Documentation about the policies and routines was limited and work flows needed to be defined in greater detail.

### Technical issues

Building a flexible architecture is important but this can make it difficult to determine what performance will be expected when exchanging data between the different parts of the system. By using an integration platform, it was possible to reduce

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the time and costs and at the same time creating the framework to connect to other systems in the future.

### Organisational issues

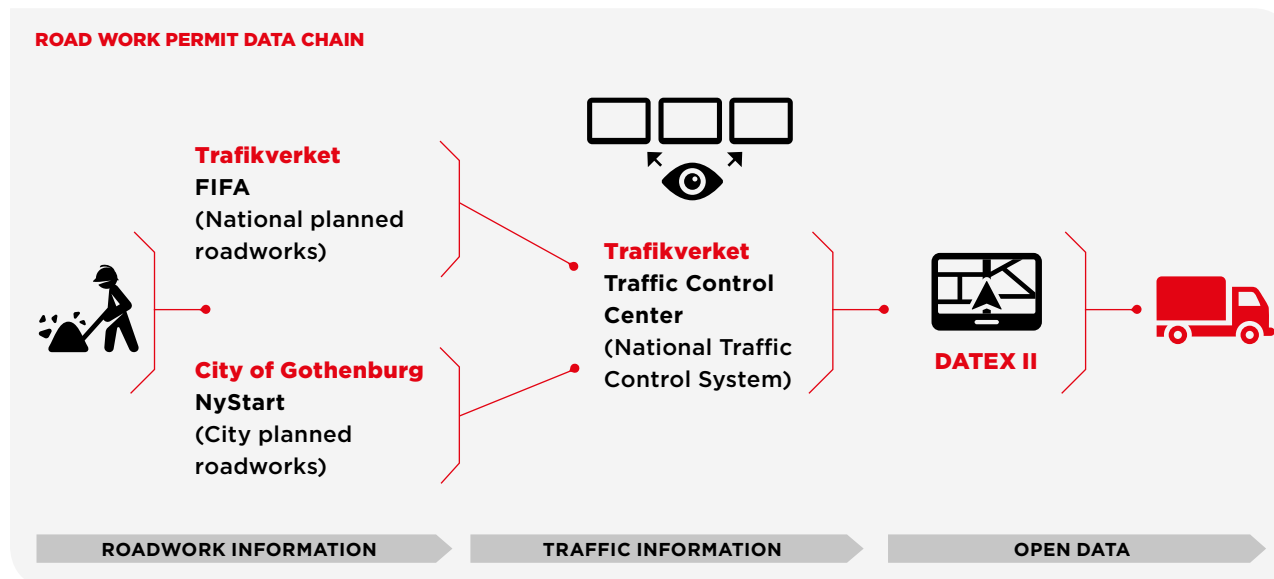
It is important to involve the organisation and contractors at all levels from the beginning. The user group is heterogenous with some not being used to computers and the willingness to actively be engaged in the projects varied greatly.

### Legal issues

it was not clear which data was appropriate to publish as open data as this may expose companies’ strategic plans to build to competitors. Even questions about agreements between the city and contractors needed to be discussed.

### Co-design

Even at the beta test stage of the system it is important to engage all stakeholders in testing and reviewing the system. By demonstrating the system, we not only explained it’s importance, we could also identify areas of improvement. It increased both the willingness to apply for permits as early as possible as well to better coordinate their work with other contractors and hereby reducing the workload on the permit administrators.



### REPLICATION POTENTIAL

  
Easiness of replication

  
Impact on mobility



# NEW TOOLS FOR FREIGHT DATA MONITORING

## FOCUS AND OBJECTIVES

The objective is to provide a real-time freight information tool for freight data collection based on the city's and users' needs.

The methodology was to process data from various devices placed on the road entrances of the city and on the transitional streets. The system – put into operation in Wrocław, Poland – allows detection and identification of vehicle parameters (incl. brand, model, colour, classification, dimensions, etc.) in order to have a constant control over all analysed freight vehicles.

Finally the project aims to make use of the gathered data to provide:

- dangerous goods identification, tracking and live update
- prevention and support to law enforcement of oversized vehicles causing damage to the city infrastructure (road, bridges, etc.).

## Situation and challenges

Urban freight transport has to cope with a variety of logistic schemes, urban policy measures (e.g. environmental and delivery zones, vehicle length and weight restrictions), traffic and routing regulations (e.g. for heavy haulage and dangerous goods transports), unpredictable traffic situation, and also IT solutions focusing to improve the efficiency of logistics operations through the use of information technology.

Thanks to the availability of real-time traffic and freight vehicle data (e.g. overloaded trucks, dangerous/hazardous goods transport), freight vehicle movements and routing can be monitored, controlled and organised in a much more effective and efficient way. The use of data and ITS technology can help to reduce operating costs, improve journey reliability and time, and cope with unexpected incidents.

Wrocław is equipped with an ITS Operation Centre which handles a large range of traffic information and manages the private, public and urban freight traffic flows. Due to the constant increase of traffic, especially urban freight, there is a strong need for a more precise freight vehicle monitoring and flows management.

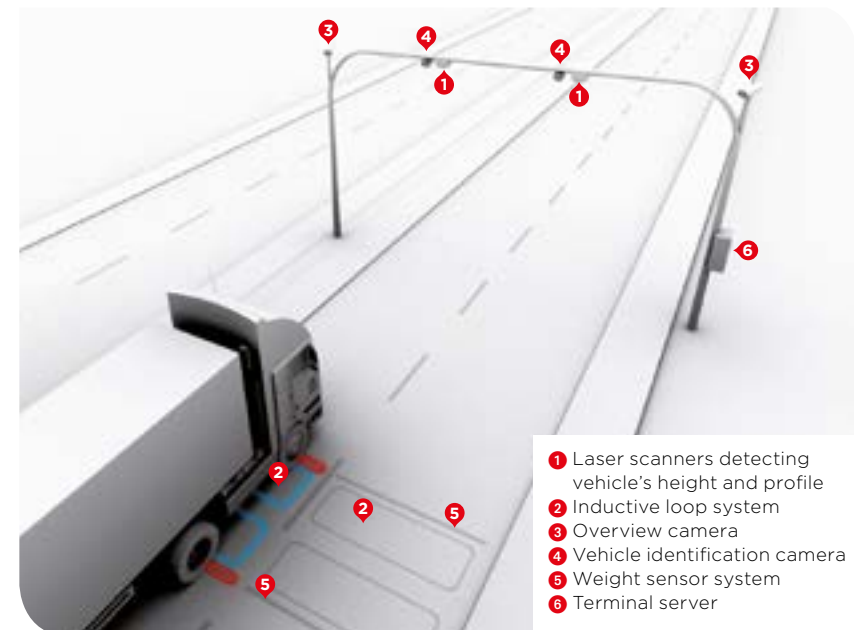
## Approach

The existing system architecture consists of three main components: *Terminal*, *Monitor* and *Central Data System* (backed by a database). All of these components were developed during the project.

*Terminal* is a software application running on embedded devices installed in the road infrastructure ITS.

It is responsible for sending gathered data from its components (ADR plate recognition, ANPR, WIM) to the Central Data System. The Monitor central management system controls and manages the different operating devices, and displays all gathered data. Data can be freely chosen and filtered. The collected data are transmitted to a Central Data System, where they are archived and analysed statistically.

## FREIGHT DETECTION INFRASTRUCTURE







The base of the system and source of data are the Measurement Points that are installed within a road section, partly positioned over a lane and connected by optic fibre or in case of emergencies via the LTE network.

### Results

All autonomously operating measuring points are sending data via wireless communication and by optic fibre. Hereby, the traffic and routing messages are sent by the communication device in real-time. The system sends data to the traffic control centre (for an updated overview of the city's traffic situation) and to drivers through client devices (for instance navigation systems or any other real-time warning system).

The achieved results are as follows:

- Recognition accuracy of vehicle number plates is 99%
- Vehicle detection accuracy is 99%
- Weigh recognition with a relative error [%] for reference vehicles is around 4%
- Height estimation inaccuracy is 0,3%
- Squared error for width and length estimation is between 1-7%
- Recognition of vehicle classification is 97%

- The system is intended for full vehicle automatic recognition without human intervention.

### Lessons learnt

#### Technical aspects

All the tests executed with real-time freight information showed that the developed system operates more effectively than previous ones. Through the improved hardware components, a higher quality of

freight data and a better interaction with the software could be achieved. Implementing further installations of the system around the city would improve the efficiency and accuracy of the city's traffic management control system.

#### Implementation

The developed system is easy to install in every European city after meeting some specified requirements. The solution developed by



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Neurosoft provides convenient API that allows any urban ITS centre to obtain information valuable for its purposes.

Installation of measurement infrastructure can be critical as it cannot be installed without prior consultation with the local roads manager. Installation itself requires intervention in the road surface in order to install weighing sensors and gantry installation where the telematics devices will be located.

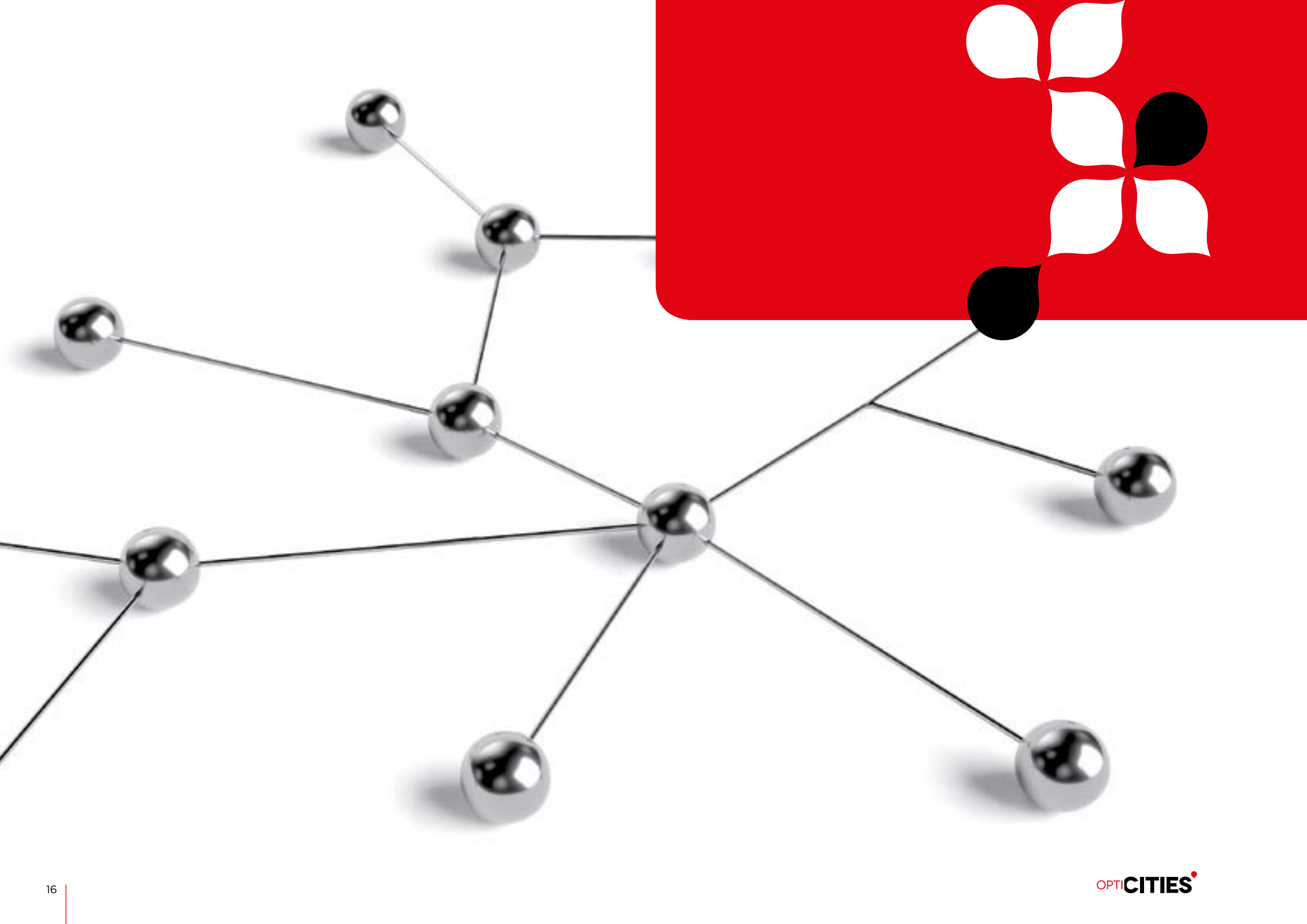
#### REPLICATION POTENTIAL



Easiness of replication



Impact on mobility





# OPEN ITS SYSTEM

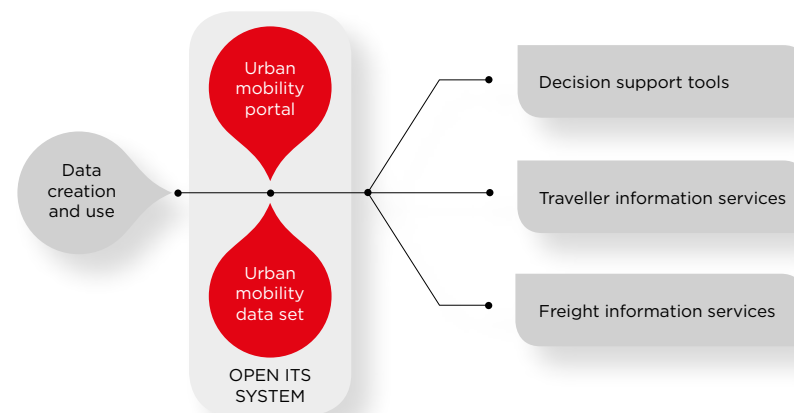
## [ OBJECTIVES ]

- Allow interoperability of information services in any European cities, whatever the data available and the services proposed
- Foster continuity of services from a user perspective, whatever the transport mode, with a focus on service continuity between cars and other modes
- Foster cooperation among public and private stakeholders to deploy cost effective services
- Define a contractual framework allowing data exchange among public and private partners

**MOBILITY PORTAL  
DESIGN AND INTERFACE  
SPECIFICATION**

**PUBLIC-PRIVATE  
CONTRACTUAL  
ARRANGEMENTS**

**MULTIMODAL  
URBAN MOBILITY  
DATABASE MODEL  
AND ARCHITECTURE**



# MOBILITY DATA PORTAL

## FOCUS AND OBJECTIVES

The Mobility Data Portal is defined in OPTICITIES by three components:

- **Standard mobility datasets** allow the connection between transport modes data that are usually managed individually
- **Standard interface to multimodal data and journey planner** as the single point of access to multimodal data and services in the city's data for any application or service provider.
- **Contractual arrangements** enabling cities to aggregate mobility data and make it available to re-users in order to facilitate the creation or the enhancement of MMIS with viable business cases.

## Situation and challenges

Different organisations hold data for different kinds of transport and use different tools and systems for data collection and provision, which may not be compatible with others, and which restrain data re-use.

At urban scale, improved data collection in a holistic approach, gathering and connecting all this information together in a multimodal dataset, and making it available through a standardised interface to any third parties with relevant rules, have the potential to make traffic flows more efficient and support individuals in choosing more sustainable transport options.

## Approach

OPTICITIES data management architecture proposal:

- Minimize the modifications necessary to existing systems
- Include data translations as temporary processes
- The Mobility Data Portal operates as the unique access point to the city's multimodal data and services (Journey planning, etc.).

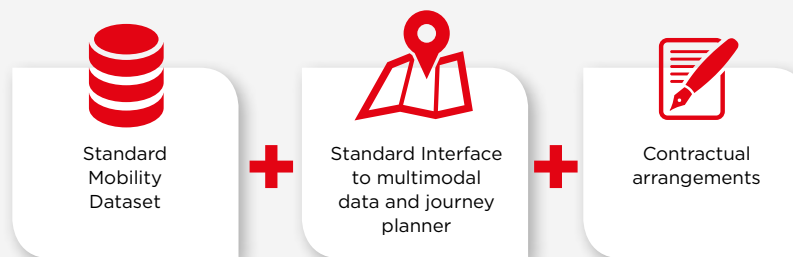
## Results

The State of the Art review with regard to existing standards and gaps to be addressed by OPTICITIES demonstrated that for the major part of the urban transport system, data standards already exist. On the other hand, the existing "data infrastructure" in the cities is generally quite comprehensive but has to be adapted to those standards. As this requires a long-term process migration scenarios have been defined. They contain recommendations for long-term, transitional and temporary scenarios.

Three scenarios have been considered for a smooth implementation of the Mobility Data Portal and its standardised interface in a city, according to their different needs and existing systems:

- A temporary scenario, detailing the practical possibilities in the very short term before the shift towards the transitional scenario
- A transitional scenario, defining the target to be achieved in the short term. This scenario only considers the data categories selected in the OPTICITIES Data Model
- A long-term scenario, defining the theoretical target to be achieved by the cities in the long run, where all services of the interface are provided.

## MOBILITY DATA PORTAL





#### More information

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The specifications of the interface for the long term scenario are based on European standards. For the provision of the journey planning interface, OPTICITIES selected TRIAS in order to follow the work of the CEN/TC278-WG3/SG8, and provide inputs for handling multimodal trips with new mobility services (bike sharing, etc.).

#### Lessons learnt

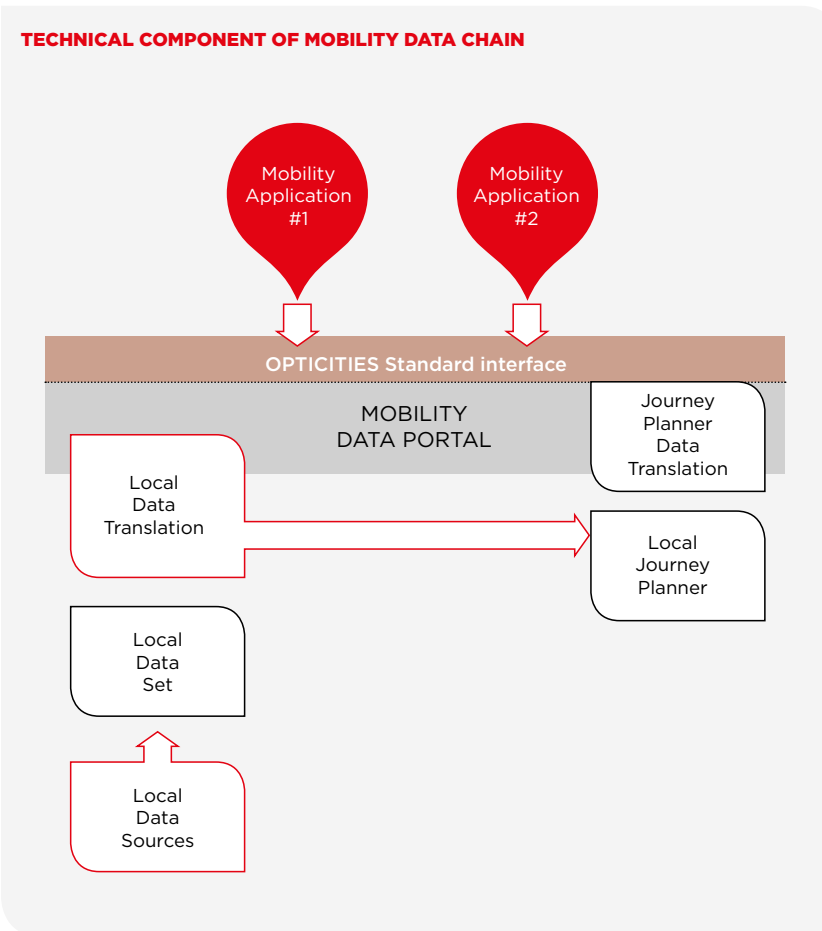
During the specification of the Mobility Data Portal all partners agreed that they should not start from scratch. Their developments should rely as much as possible on existing platforms.

Therefore, it was decided not to implement a common technical architecture for each Mobility Data Portal, considering the large investments that it would require. However, all partners agree on the requirement to unify and implement a common and standardised interface which provides access to the data sets, to the services and more specifically to journey planner services, in as many cities as possible, for as many data services as possible.

It was also agreed that the Mobility Data Portal will be the gateway for access to the mobility data sets covering its territory, in order that any third parties could access to the data and services to provide their own Traveller Information Services.

In this view, the Mobility Data Portal is indeed the unique access point to all multimodal data of the cities, and provides a standardised and open interface to its data set and services for local and third party applications. External developers could then provide services (websites or mobile applications) using these data with a minimal analysis and interpretation of the data sets.

By the use of standardised specifications and solutions, public authorities foster interoperability between European cities and reduce public expenses.



**REPLICATION POTENTIAL**

**Easiness of replication**

**Impact on mobility**

# PUBLIC-PRIVATE CONTRACTUAL ARRANGEMENTS

## FOCUS AND OBJECTIVES

Cities pursue two main objectives when dealing with data availability:

- Promote modal shift and multimodal transport behaviour through the deployment of Multimodal Information Services (MMIS)
- Foster innovation and new business models for MMIS.

Data availability is therefore a means to achieve these objectives and not a goal by itself.



## Situation and challenges

Mobility data availability varies among cities but analysis reveals convergences:

- Cities have adopted a multimodal approach (PT, road traffic and other modes). They acknowledge that modal shift will be achieved through the use of multiple transport services and not just with public transport alone
- Cities face public funding restrictions and are seeking ways to set up innovative business models to build and sustain new mobility services less dependent on public funding
- Data collection is driven by the need to deliver transport planning, traffic and transport network management and MMIS that are provided by the cities as mandatory services
- Cities have started to aggregate data coming from various organisations both public and private. They acknowledge that making a comprehensive and unique data set available for third parties is an additional and crucial driver for the delivery of high quality MMIS.

## Approach

Key principle is that cities aggregate all mobility data (private and public) available on their territory and make it available to third parties. Third parties will use this data to set up high-level MMIS that are consistent with requirements of public mobility policy and independent from public funding where:

- The Mobility Data Set (MDS) does not include personal data
- The MDS may include data with different levels of processing, from raw data up to relatively highly processed data (e.g. an API handling journey planner requests)
- The MDS must be capable of integrating data from private data producers (such as car industry stakeholders).

## Success factors

- Establish a memorandum of the city's objectives and the rationale of a contractual arrangement in the preamble of the contract
- Define the minimal contract duration, so that the re-users are guaranteed that the city will maintain the MDS provision

- Define the content and technical modalities of MDS provision by the city, and the level of service provision
- Describe the city's objectives and its strategy/agenda in terms of modal shift in the preamble of the contract. Present the roadmap for providing MMIS through its own channels (content, media, dates of implementation...) in order to help the private stakeholders to define their business cases
- Include the specific requirements of conformity with public policy, per data category. Annex useful reference documents to the contract, if necessary
- Preserve the city's possibility of inquiring upon the conformity of a re-user's service with these requirements (e.g. audit). Preserve the city's capability of stopping or not renewing the contract with a re-user who has been non-conformal to re-use conditions
- State the common willingness for a regular dialogue in the preamble of the contract.

**More information****Jean Coldefy**

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	MMIS market situation	OPTICITIES approach
<b>Service scope</b>	<ul style="list-style-type: none"> <li>▶ Existing services are limited in terms of modal, geographical and temporal coverage</li> <li>▶ They are mostly single mode services with insufficient historical, real-time and geographical coverage.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Facilitate the access to data on mobility services in cities (incl. real-time) for re-users and promote the elaboration of high-level and real-time MMIS.</li> </ul>
<b>Willingness to pay</b>	<ul style="list-style-type: none"> <li>▶ Low due to the poor added value of existing services and market context. End-users tend to take travel information for granted due to the free provision of information services by monopolistic players (public and private) that misrepresent the true service value.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Let the private sector provide real-time MMIS with high added value</li> <li>▶ Let the cities provide open data for free to facilitate growth in the MMIS market.</li> </ul>
<b>Third parties' access to data</b>	<ul style="list-style-type: none"> <li>▶ The need to open up data has been largely accepted, but sustainable business models based on open data access and initiatives have yet to emerge.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Make all pertinent mobility data accessible through a MDS, including real-time data. Make it available for commercial re-use by third parties.</li> </ul>
<b>Market competition</b>	<ul style="list-style-type: none"> <li>▶ A monopolistic market:             <ul style="list-style-type: none"> <li>- PT operators under exclusive public procurement contracts providing travel information to end-users</li> <li>- Big internet players providing free services in order to monopolise a market audience</li> <li>- Public services provided for free that do not leave enough market space for private MMIS to find their audience.</li> </ul> </li> <li>▶ In this context pure MMIS players and SMEs have little chance to exist in the marketplace.</li> </ul>	<ul style="list-style-type: none"> <li>▶ Provide data to all MMIS providers in an inclusive approach, based on contracts with data re-users that foster fair competition and create an equal playing field</li> <li>▶ Focus on quality of services, based on accurate, timely and reliable data, that fits to each city's context.</li> </ul>

**REPLICATION POTENTIAL**

**Easiness of replication**



**Impact on mobility**

# MULTIMODAL URBAN MOBILITY DATABASE MODEL AND ARCHITECTURE

## FOCUS AND OBJECTIVES

In OPTICITIES vision, data management is based on two major aspects:

- Consolidation of all data available at local level, combining multiple sources of urban mobility data from all modes
- Provision of real-time information for all modes, available anytime, anywhere.

By specifying a reference architecture and developing a conceptual interoperability framework for urban mobility support standards, this will reduce the dependence of single databases, in which each entity that operates in the city holds the data.

## Situation and challenges

The Multimodal Urban Mobility Dataset has to address a broad range of different data from different sources and different purposes within each city.

- Various services have different data collection, processing and information provision requirements:
  - What are the data types already considered for the OPTICITIES services?
  - What are the data types NOT considered for the services?
  - Are there data types / areas without supporting standards?

- Even within a service, different data areas and standards have been developed in a separate way: traffic data, public transport data, freight data...

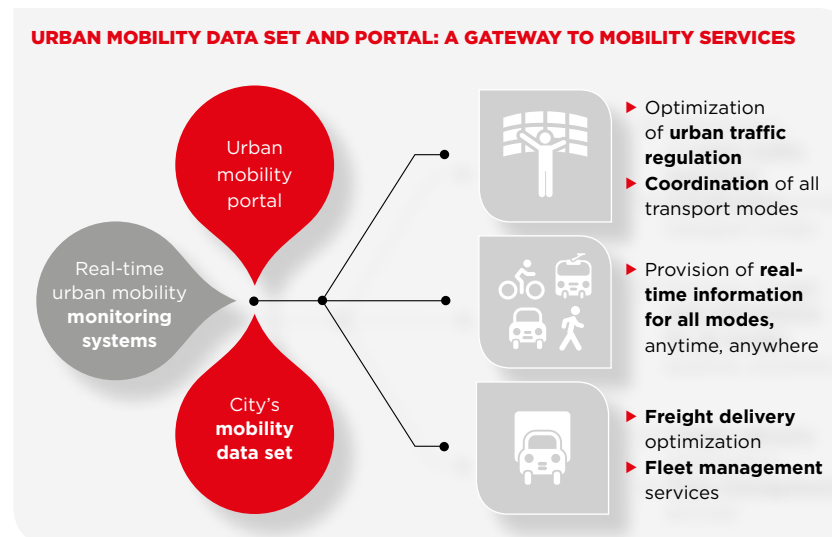
This has often resulted in a number of different systems, each delivering service to a small part of the whole urban mobility data management landscape.

Eventually there is no easy way to facilitate deployment of services integrating different types of data and standards.

## Approach

The methodology followed the following steps:

- Identification of datasets relevant for the use cases considered
- Knowledge about the data currently available/considered in each city
- Knowledge about the starting point in data management implementation terms for each city and use case:
  - Identification of systems and services represented
  - Identification of data sources available and necessary
- Identification of preliminary complementary datasets based on previous established conceptual links between datasets
- Proposals for data categorisation and the overall interoperability framework
- Standard gap analysis and proposals for extensions
- Standardisation activities: development of new standards, extensions, or recommendations on existing standards.







**More information**

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**Results**

OPTICITIES multimodal urban data categorisation proposal is presented in the diagram below. It groups different datasets for relevant use cases and services, and also provides a visual idea of the lifetime of data-static reference through real-time dynamic data.

The use in the cities of relevant CEN and ISO Transmodel, SIRI, NeTeX, DATEX II and GDF standards, as well as *de facto* initiatives such as GTFS, are considered in the production of this data categorisation and supporting standards framework.

OPTICITIES strongly contributed to the currently ongoing standardisation activities at ISO and CEN related to the connection between different datasets to share a common reference, especially between road traffic and public transport data.

Deployment of this framework is supported by the creation of the implementation profiles, which are additional documents to a standard or set of standards specifying rules for implementation in a given context, together with specific conformance testing procedures definition.

**Lessons learnt**

Implementation of use case data management elements is a complex task that depends on different aspects of varied nature:

- Technical
- Organisational and administration-related.
- Policy-related, existing business model-related.

It is necessary to foster cooperation within cities to ensure the maximum impact on the proposed data management implementation profiles.

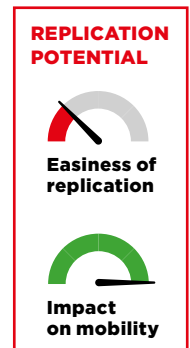
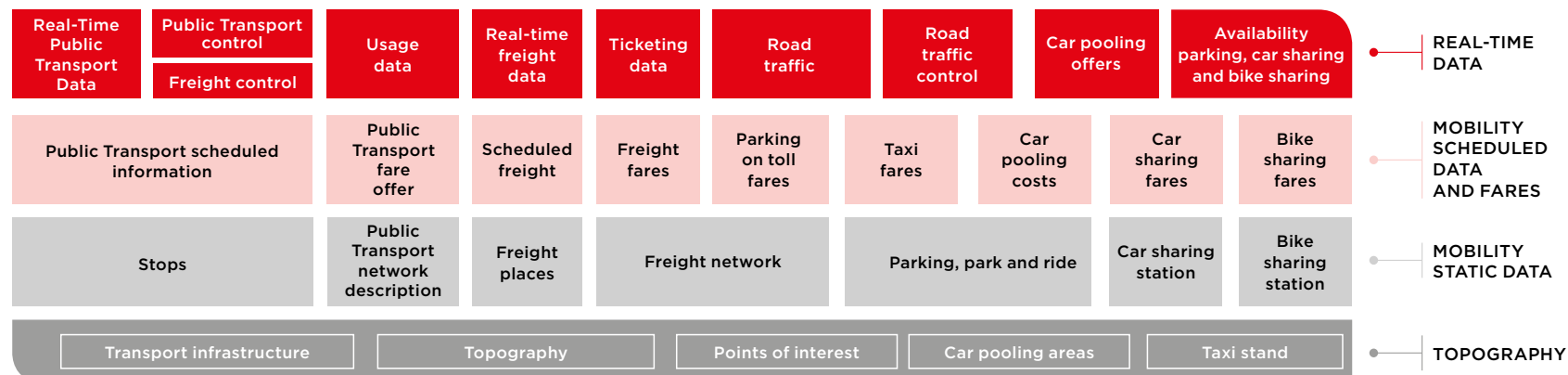
Implementation of the multimodal dataset considers different implementation scenarios for profiles, and has prepared a detailed guidebook to

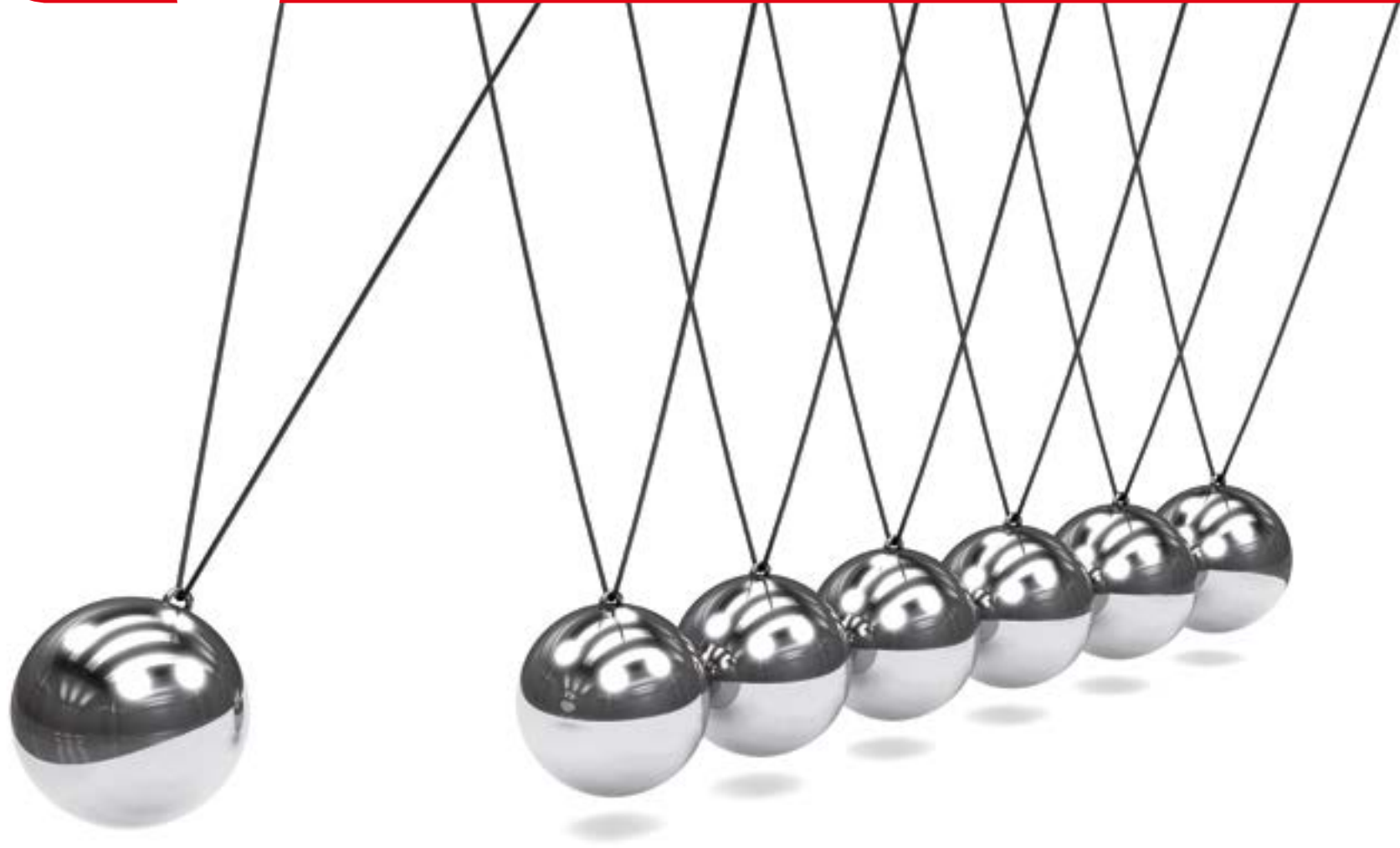
support deployment of urban mobility data management systems/services.

The objective is always to minimise the migration effort for the cities to provide the desired services and to ensure that these efforts will be reasonably well-protected in the future:

- Respecting the city’s policies and currently implemented elements
- Taking into account the trends in the EU standardisation efforts. The Commission implementing decision (EU) 2016/209 on urban ITS standardisation supports the overall approach of OPTICITIES in its standardisation of the multimodal dataset
- Close relation with standardisation groups
- Looking beyond the OPTICITIES timeline.

**OVERVIEW OF DATA CATEGORIES**



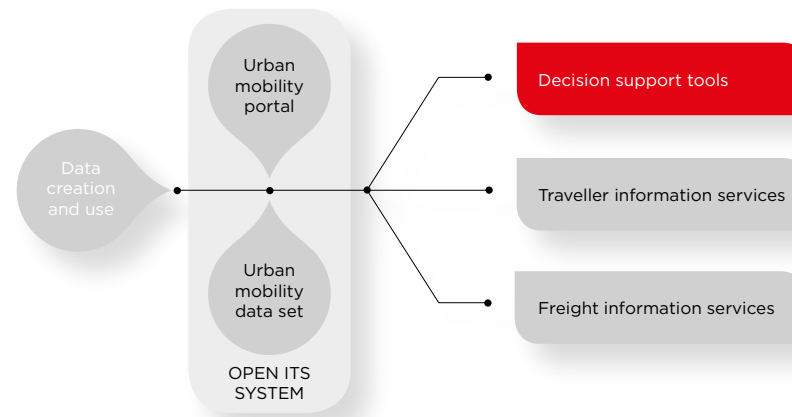




# DECISION SUPPORT TOOLS

## [ OBJECTIVES ]

- Reinforce the multimodal approach to implement holistic network management solutions
- Support automated intervention processes by exploiting new technologies and tools
- Reduce response and recovery time to transport incidents and events
- Anticipate operational risks in transport and contribute to an intelligent decision making process.
- Support policy makers, transport planners and transport operators to facilitate inter-modality and soft modes use



**MULTIMODAL NETWORK  
MAP FOR PLANNING**

**MULTIMODAL NETWORK  
MANAGEMENT**

**INTEGRATED SOFT PRIORITY  
FOR PUBLIC TRANSPORT**

**TRAFFIC PREDICTION  
IN TRAFFIC MANAGEMENT  
CENTRES**

# MULTIMODAL NETWORK MAP FOR PLANNING

## FOCUS AND OBJECTIVES

To reach a more sustainable mobility in a metropolitan context, Public Transport Authorities need several type of data related to multimodality.

A number of geo-localised datasets are needed for planning and also to provide information to public transport users.

The objective for the Metropolitan area of Torino was to conceive an open solution, aiming at displaying on a map information on different transport modes (bus, metro, train, bicycle, taxi, car sharing, traffic limitations) and complementary information (population, health and school buildings, markets, tourism and culture structures). This tool will facilitate transport planning with an intermodal approach including a focus on public transport and soft modes

## Situation and challenges

In an Italian context, the following challenges need to be addressed:

- Data are produced by different transport service providers (such as bus, train, bike sharing and car sharing operators) and by different public transport authorities (municipal, regional and national public agencies)
- Required data have different levels of availability, usability and are not updated the same way
- Data exchange formats are not harmonised
- Cities produce a wide range of data, but are not aware of the value of geo localized data. Updating data layers, require methods they don't always have.

## Approach

Since the beginning of the project a wide range of final users (decision makers, officials of the transport sector and transport operators at regional and municipal level) have been involved to understand their needs and expectations.

We can draw many lessons from the consultations:

- The need to reduce data fragmentation among different actors and different transport services
- The wish to share data and indicators
- The need for collaboration to save resources, request funding, act for planning (SUMP).

Two stages were needed (data collection and data standardization activities) before CSI Piemonte developed a prototype that met the requirements.

The tool was tested and improved thanks to more than 14 training and experimentation modules (LABs) with more than 50 participants.

## Results

The first result has been the Multimodal Network Map, a webportal including a map viewer (to visualise on a map all collected data layers, consult data attributes, search data through spatial or alphanumeric filters), an indicator viewer, and two other planning tools for accessibility analysis and multimodal trip calculation.

It can be defined as a tool box, with different solutions to be used according to the needs.

As a result, we can mention the update of several data sets in the open data portals, and some significant data conversion in standard format (GTFS format). These led to a definitely more complete picture of the current transport system.

Moreover, also thanks to the training sessions, ability to use data and awareness of the importance of creating, updating and sharing data have been increased, which will lead to new policies and actions towards sustainability.

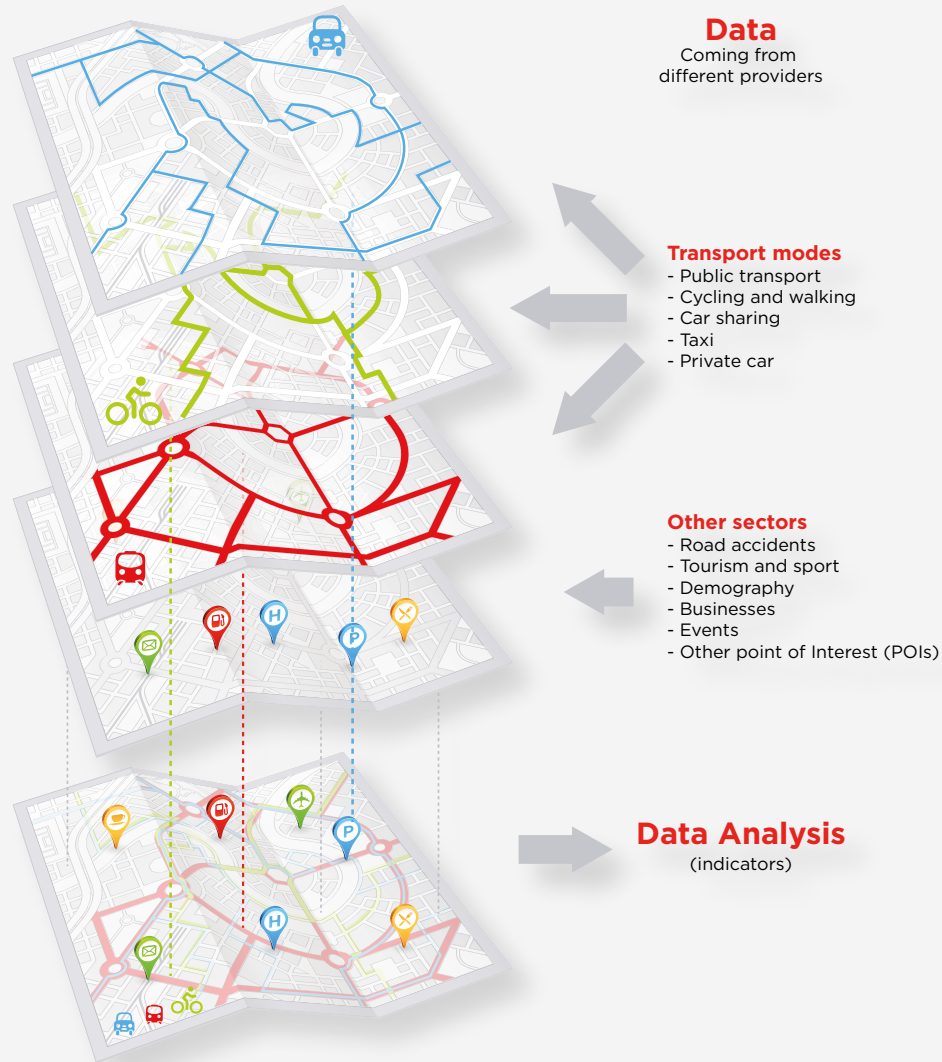
The use of the tool also leads to a new attention in the preparation of next contracts with service operators to provide data to the city.

The developed tool is accessible via <http://vm-osotp.csi.it/opticities/en/>



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### MULTIMODAL TRANSPORT MAP CONCEPT



### Lessons learnt

#### Technical aspects

- Thanks to the modular structure the evolution of the tool would easily fit future needs
- The adoption of open source solutions contributed to their evolution and to the financial sustainability of the tool
- The map viewer uses data delivered through web services (WMS, WFS) and, in most of the cases, available as open data. In case of modification, the system automatically visualizes the updated information. This approach also encourages to update data sets.

#### Organisational issues

The system highlights the need of a structured process to collect geo-localised and updated data.

Both in large cities, as Torino, and small ones, this requires a quite strong organisational effort.

#### Training and networking

The involvement of a wide range of users facilitated the design of the tool, and a more widespread awareness about current data fragmentation and missing information.

#### REPLICATION POTENTIAL



**Impact on mobility**



**Easiness of replication**

# MULTIMODAL NETWORK MANAGEMENT

## FOCUS AND OBJECTIVES

- Supporting the operators, the public transport authority and the management centre to deliver updated information to their network
- Provide quick response and ensure that all the involved actors, as well as users, are well informed.



## Situation and challenges

The Madrid region public transport system gathers 40 public and private operators with a wide range of transport services, information and infrastructure. Consorcio Regional de Transportes de Madrid, as the Public Transport Authority of the region, is in charge of its coordination and the establishment of the conditions under which services must be provided to clients.

In this context main challenges are:

- Providing users with accurate multimodal information, to optimise their trips and/or plan the most convenient route depending on real-time status
- Develop integrated, efficient and reliable tools for Madrid's CITRAM operators in order to enhance the efficiency of their operations.

## Approach

The Graphic Management Tool has been developed to improve information management and support CITRAM operators in the quick delivery of answers and solutions to all involved stakeholders and users.

### Early Warning System

The tool is able to identify circumstances that may generate an incident that could interfere with the Public Transport System.

### Decision and Orchestration Engine

Developed for CITRAM operators, the module can take decisions and propose solutions to certain situations. Other stakeholders such as PTOs, Emergency Services, public transport users, among others, will take advantage of it.

### Information Distribution Module

In case of abnormal identified situations the tool disseminates a set of pre-defined (but customisable) messages through different channels: fixed on-board panels, web pages, mobile applications, email, etc. Targeted transport operators and users thus benefit from specific and circumstantial information.

## Results

The implementation of these tools have influenced the operators' and connected stakeholders' daily work.

### Public transport users

- Information quality improvement
- Targeted warnings about problems on the PT system
- Unified multimodal information on the whole PT system
- Alternative options linked to the decision makers
- Real-time multimodal information on multiple channels
- High quality information, accurate and official.

### Public transport authorities

- Better knowledge on the public transport system status
- Improved coordination and shared strategies with PTOs and other stakeholders.

### Public transport operators

- Information quality improvement
- Faster decision making
- Decreased impacts of incidents
- Improved operation efficiency.

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#### Users of the tool

- Quicker detection of incidents
- Reduction of response time
- Automation of management and action, reducing human errors
- Enhanced analysis if information comes from different sources
- Improve user efficiency and decision making
- Improve the coordination with PTOs and other stakeholders.

#### Other stakeholders

- Have a valid interlocutor
- Received information with higher quality.

#### Lessons learnt

##### Operators interface and training

The involvement of the end users from the beginning of the process has been crucial. The development of a tool based on a well-known interface and the creation of user guides and training periods were decisive.

##### Policy issues

The agreement gathered a large panel of public and private stakeholders, for several data sources.

#### Technical issues

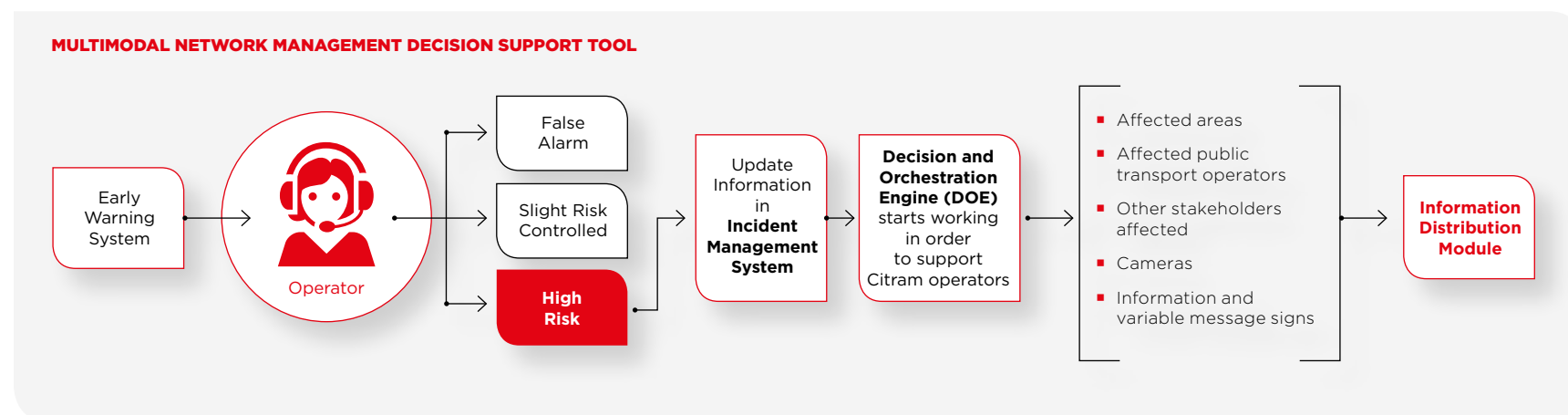
Processing the huge amount of data is rather complex. The implemented solution includes a distributed-oriented system architecture.

##### Organisational issues

Key points are reliable interlocutors within each operator, control centres, collaborative tools and trainings.

#### Legal issues

- Collaboration and cooperation agreements with other organisations and institutions, such as emergency services and the Directorate General of Traffic
- CRTM established contractual agreements with all the public transport operators
- Contingency plans linked with the regulations of civil protection of Madrid Region (PLATERCAM) and emergencies of the municipality of Madrid (PEMAM).



**REPLICATION POTENTIAL**

**Easiness of replication**

**Impact on mobility**



# INTEGRATED SOFT PRIORITY FOR PUBLIC TRANSPORT

## FOCUS AND OBJECTIVES

Provide flexible and easy-to-deploy public transport priority for buses and trams with a minimum footprint for the physical infrastructure.



## Situation and challenges

The major challenges to establish public transport priority in a medium sized city:

- A change-out of current legacy systems must be pursued without disrupting critical ITS services
- Integrations to other legacy ITS systems is a driver in complexity of use cases and roll-out planning.
- Simplified work processes crucial to support execution of infrastructure projects
- Multi-stakeholder environment requires that different infrastructure owners should be able to handle operation and maintenance
- Safety integrity of tramway switches defines mandatory requirements
- Increased automation of driver interaction with tram switches should be accounted for in system design
- Maintenance planning and operations requires high knowledge of system functions and logging of field actions.

## Approach

Two functions are critical for the daily operations of the public transport system:

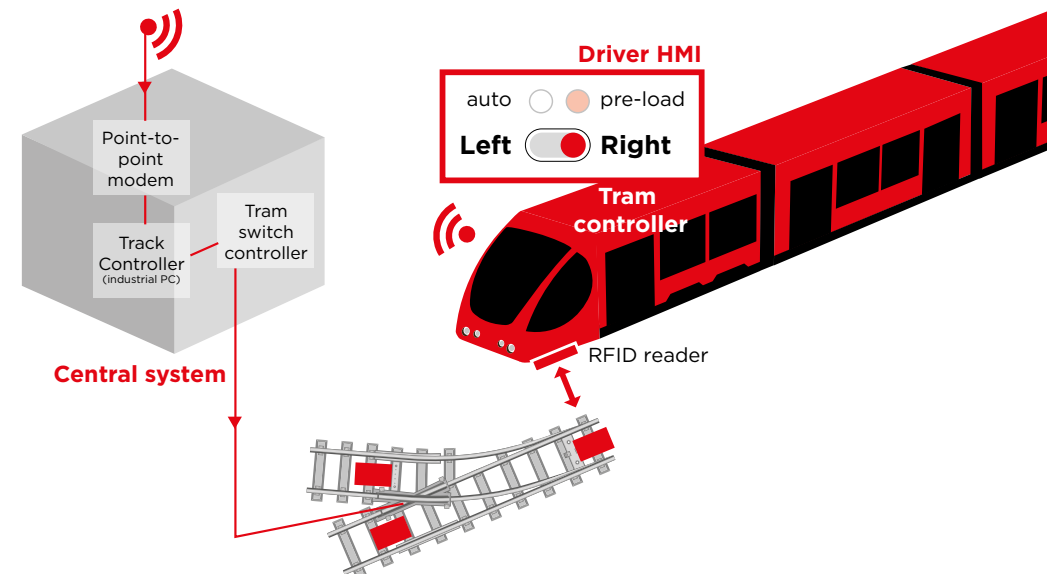
- The public transport priority at crossing lights
- The tram switch operation.

The public transport priority secures the smooth flow of prioritized traffic and grants priority for buses, trams and emergency vehicles at traffic lights. The tram switch operation

assures smooth routing in the switch points for the trams, i.e. lets the tram driver select left/right track.

Soft Prio, is a modular system architecture based on experiences from the operations of legacy systems and modern technologies for positioning and communication. An easily adaptable system is established based on open source and off-the-shelf technologies without lock-in effects of proprietary technologies.

## TRAMWAY SOFT PRIO EQUIPMENT





## Results

The urban transport authority of Gothenburg (Trafikkontoret) has developed an innovative, yet simple, system to secure traffic flow of public transport vehicles (buses, trams) within an urban environment. The system is currently (April 2016) in operation in all the city buses in Gothenburg (approx 500 buses) and roll-out is in execution for the complete tram network (58 switch control sites has been deployed up to Aug-2016).

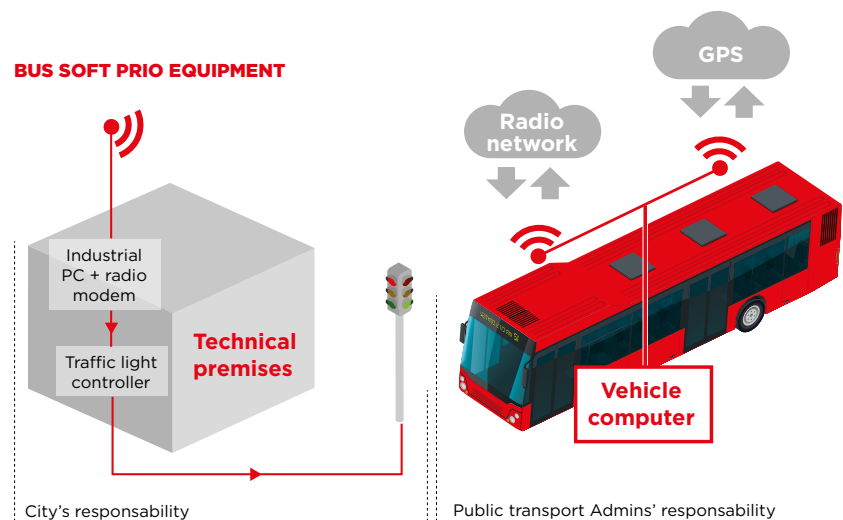
The core technologies chosen are GPS (bus) and passive RFID technology (tram) for vehicle positioning, Tetra (bus) and Direct link (tram) for digital communication and a

versatile Linux-based industrial PC for the controller functions implementation (both road/track side).

Further, the use of modern and open technologies also enables innovation in other projects that requires geo-fencing and tram positioning such as:

- Automated tram switch requests
- Tram track friction modifier application control and
- Control of catenary power surges.

The system and these innovative spin off projects are described in the Deployment Guidelines for Integrated Soft Priority Public Transport.



## Lessons learnt

### Close participation with the tramway maintenance staff assured smooth deployment

By early inclusion of the operative staff in the project, the ownership of the change process was shared and not-invented-here related issues were minimized. Also minor design changes to streamline maintenance processes could be effectively carried out. One spin-off effect was also that the maintenance staff could participate in the deployment and hence the hand-over to operations became smooth and efficient.

### Ownership of the solution creates real options for the future

Since Trafikkontoret has secured intellectual property rights to the results (including all design material, application source code etc), the solution can be reused in other projects with similar requirements. This lowers the barrier for spin-off ITS investments and contributes to the ITS cluster in Gothenburg and also enables dissemination in European cities through local initiatives.

### Close cooperation with the stakeholders minimized gap between specified use case and real world.

By close dialogue with the tram operator and the Public Transport Administration regarding installations and the human-machine interface, the use cases were validated by proof-of-concept installations done in close cooperation which minimized user-induced deployment challenges.

### More information

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### REPLICATION POTENTIAL



Easiness of replication



Impact on mobility

# TRAFFIC PREDICTION IN TRAFFIC MANAGEMENT CENTRES

## FOCUS AND OBJECTIVES

Currently cities manage traffic congestion by reacting to incidents and events as they happen.

With increasing demand on the urban road network we recognise the need to apply management strategies more quickly to achieve maximum benefit.

Our objective has been to test complex, innovative solutions that enable proactive management of road traffic by the integration of predictive traffic information to the existing traffic control centres.

Our approach to traffic prediction resulted in focusing on methodologies based on the use of micro-simulation modelling and predictive algorithms designed to predict traffic conditions up to 60 minutes in advance based on current traffic demand.

This effectively provides traffic managers with a decision support tool that allows them to manage their strategic road network more effectively.

## Situation and challenges

The delivery and use of predictive information delivers a number of challenges in terms of:

- Identifying data sources that are reliable and accurate for use
- Defining the routes or area within the city that will benefit from traffic prediction
- Establishing a normalised baseline for traffic conditions on a day to day basis
- Establishing a confidence level in the alerts generated by the system
- Categorising the impact and severity of the alerts generated
- Defining traffic management strategies in reaction to traffic prediction scenarios.

## Approach

Developing traffic prediction by:

- Utilising existing data sources that are typically available within any traffic management centre. This enables a traffic prediction system that utilises existing systems and does not require investment in additional data sources
- Defining key performance indicators and operational methodology
- Defining strategic routes for predictive algorithms and core city areas for city mezzo simulation based on two layers
- Verifying alerts by using independent third party data sources.

## Results

All alerts have been recorded and verified as to the confidence level and the expected impact on the road network. The predictive algorithm is generating a high number of alerts daily and over 90% of these can be verified as genuine using independent real time traffic information systems.

Due to the number of alerts generated it is not possible to react to all of them so attention has focused on identifying the top 10 alerts that occur with the most frequency with a high impact on traffic. Traffic management strategies can then be determined to mitigate these alerts, either by manual or automated responses, and their success determined through the system.



#### More information

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### Lessons learnt

The implementation of traffic prediction service is challenging and reliant on high quality data from the road network. Therefore, data quantity and quality needs to be high for both historic and real time data.

#### Establishing baseline data

It takes time to determine route(s) or geographic area and establish the baseline data sources in terms of real time and historic data.

#### Confidence factor

Establishing the verification method for alerts before taking action is a high priority task as it determines the overall performance of the traffic prediction quality. Initially this must be a manual process that can, over time, be automated.

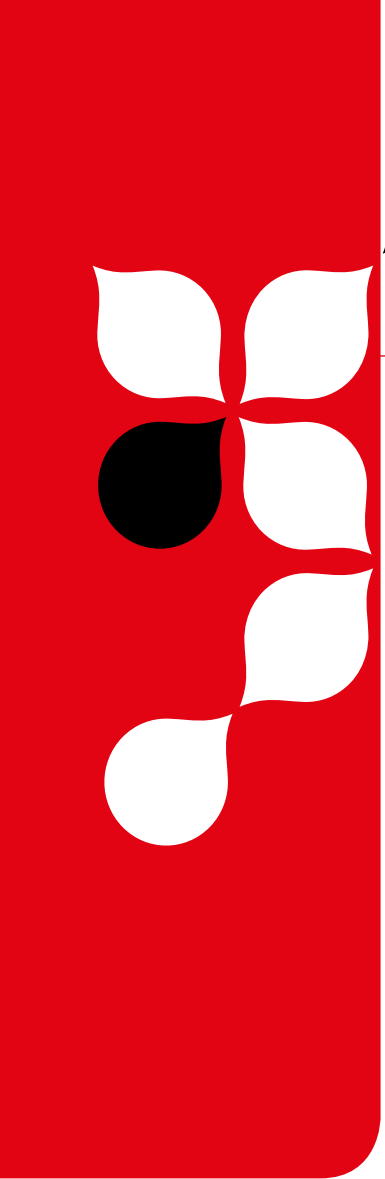
#### Micro-simulation

Model run time has to be completed in very short time scale.

Operational staff must be engaged with the use of new system from very early stages to gain their confidence in the system and its use.

### TRAFFIC PREDICTION VISUALISATION MODULE



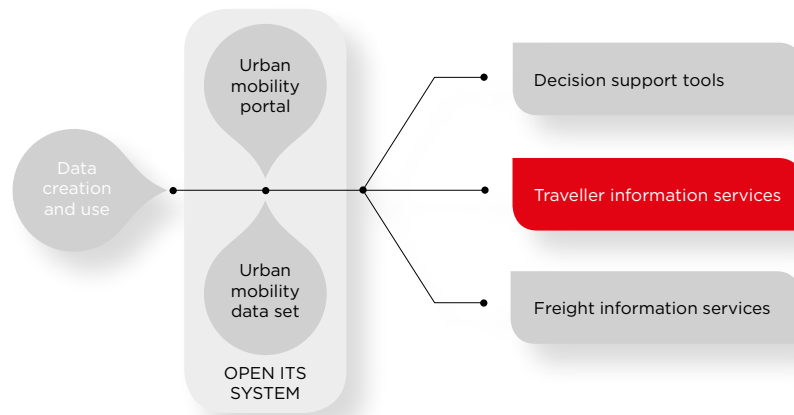




# TRAVELLER INFORMATION SERVICES

## [ OBJECTIVES ]

- Develop very high level information services for travellers thus opening the door for new business models
- Ensure strong cooperation between public transport authorities, car manufacturers and traveller information service providers
- Demonstrate the interoperability of the OPTICITIES standard for urban dataset through traveller information services delivery



MULTIMODAL REAL-TIME  
URBAN NAVIGATOR

INTERFACES SMARTPHONES/  
IN-CAR NAVIGATION SYSTEMS

REAL-TIME  
CAR POOLING

# MULTIMODAL REAL-TIME URBAN NAVIGATOR

## FOCUS AND OBJECTIVES

An essential pre-requisite to allow end- users to choose between different transport modes or to combine modes in a smart way is the availability of information about alternatives, including real-time information on the status of different networks, trips and vehicles.

OPTICITIES focused on the development of multimodal urban journey planners to develop, test and assess high-level innovative information services.

An important objective was the creation of interoperable solutions, thus showing the advantages arising from the multimodal urban portal developed within the project:

- The multimodal urban navigator developed by Cityway for Lyon was adapted to use the Torino dataset
- HaCon's multimodal urban navigator was adapted to use the Gothenburg and Lyon datasets
- An API was added to Cityway's multimodal urban journey planner to provide dynamic car routing services for third-party apps, especially for HaCon's Lyon navigator.

## Situation and challenges

Within OPTICITIES, multimodal urban navigators were developed for four cities, with a different focus, depending on the respective situation:

- The **Madrid** navigator, developed by ICCA, was designed to support the shift to public transport and addressed information on stops, lines and Points of Interest (POI). The main challenge was the use of highly fragmented data for a large number of public transport operators
- In **Lyon**, the main challenge was to enhance Cityway's navigator to provide preference-based multimodal suggestions and to connect HaCon's navigator to Lyon's multimodal urban portal
- In **Torino**, a Multimodal Urban Portal was set up during the project. The main challenge was, to connect Cityway's navigator to this data platform and to integrate a local carpooling service
- In **Gothenburg**, integrated public transport data was available and could be connected to data available from the City of Gothenburg. The main challenge was to provide a user-friendly interface to HaCon's navigator.

## Approach

The services developed were based on the different cities' datasets and utilised – as far as possible – the interfaces defined within the project and provided by the multimodal urban portals in the different cities.

As an overall approach, a global function list for Multimodal Urban Navigators was defined. Using this list, the functional scope of the different navigators could be charted.

## Results

The following urban navigators were developed and tested:

- **“Mi Transporte”**, the Madrid urban navigator provided as Android and iOS app. It provides location-based information for the different transportation modes around the user's current position, via an augmented reality view, as well as real-time information about the public transport network in and around Madrid

### MI TRANSPORTE | MADRID







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- **“OPTYMOD”**, Lyon’s urban navigator mobile app for Android and iOS. It can be used to calculate preference-based multimodal routes, including real-time information on the status of the public transport and road network
- **“TUeTO”**, the urban navigator for Torino, uses the system architecture from OPTYMOD adapted to the Torino dataset. Additionally, it provides information from a local carpooling provider as part of its intermodal routes
- **The Lyon urban navigator** implemented by HaCon was implemented

as an Android app, mainly to explore interoperability aspects. It is able to provide multimodal routes including bike-sharing and car-sharing segments, as well as suggestions using park and ride

- **“SmartMoov”**, the urban navigator for Gothenburg is an iOS app and was distributed to test users in the Gothenburg region. Besides calculating multimodal routes, it provides a “one-field search” to ease user input and a so-called reachability search to show parts of the city that can be reached in a given time via public transport.

**Lessons learnt**

Multimodal Urban Navigators can be implemented in numerous forms and with different functional scopes. Routing is not a must-have – the Madrid navigator is a very useful tool without it.

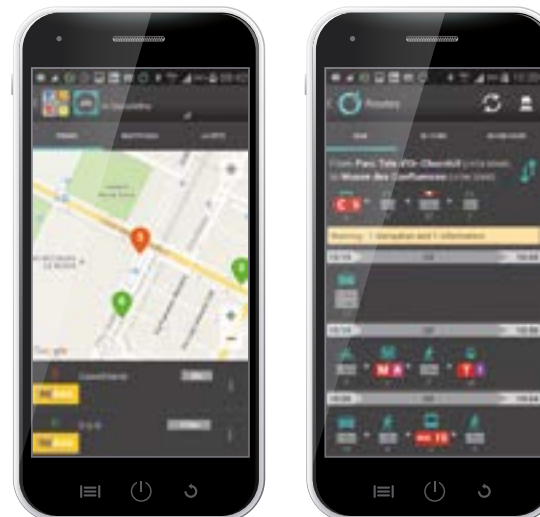
The general availability of data is a crucial point for implementing features of a Multimodal Urban Navigator, as well as data quality – reliable services need reliable data.

The test phase is a critical stage for the deployment of a multimodal navigator in a city. Gathering data from a large number of heterogeneous sources generates complex test cases, especially if real-time information is taken into account and if many different routes exist for a given A to B journey.

**SMARTMOOV | GOTHENBURG**



**OPTYMOD | LYON**



**REPLICATION POTENTIAL**

**Easiness of replication**

**Impact on mobility**

# INTERFACES SMARTPHONES/IN-CAR NAVIGATION SYSTEMS

## FOCUS AND OBJECTIVES

To include the car within a global urban mobility offer, drivers must be able to access mobility services before taking their car and while driving, in a secured way.

Smartphone applications are in general not compatible with driving, as in-car information systems must minimize visual and cognitive distraction and be reduced to the bare essential messages, thus avoiding multiple choice, mental calculation, delayed feedback, or long text reading. The design of navigation systems provided by car manufacturer takes into account such rules and should be preferred to smartphone applications while driving.

An interface between the in-car navigation system and the smartphone multimodal routing application has therefore been developed in order to provide a seamless multimodal transportation service, suitable both inside and outside the car.

## Situation and challenges

Since the key issues for integrating new mobility services in the vehicle are not related to connectivity between car and smartphone but to the software integration of the service within the in-car navigation system, our work focused on the definition of the smallest set of interfaces between these two systems in order to ease the future integration of new multimodal mobility services by the automotive industry.

Two types of interfaces were considered:

- The first interface relates to the data to be exchanged between the smartphone and the in-car navigation system
- The second one deals with the Human Machine Interface (HMI) in car. OPTICITIES has proposed recommendations to reach a safe, ergonomic and effective User Experience (UX) in regards to multimodal routing requirements.

## Approach

An agile development process has been used to implement a door-to-door seamless continuity of service for multimodal routing.

As the in-car navigation interface is usually a closed system specific to a carmaker, it was decided to develop a generic prototype allowing the full experimentation of the propose solution.

This prototype has been elaborated on a web-socket architecture which can be considered as a design pattern example for future developments by car manufacturers.

Based on these developments, a reference model has been proposed, describing the minimum data set that needs to be exchanged between the smartphone and the car's on-board system as well as the necessary HMI elements.

## Results

The following functionalities have been prototyped:

- Upon automatic detection of the smartphone by the multimedia in-car system, the on-board navigation proposes to synchronize data corresponding to the multimodal journey planned on the smartphone (mainly destination and next transportation modes)
- During the car trip, the driver interacts with the multimodal routing service through the on-board navigation HMI which displays the computed driving directions
- If a road event prevents the car from reaching the next transportation mode in due time (a train departure for instance), the on-board unit proposes an alternative itinerary computed on the cloud and received through the smartphone
- Upon arrival and once the car is parked, the smartphone automatically takes over and suggests the directions to the next transportation mode.





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### Lessons learnt

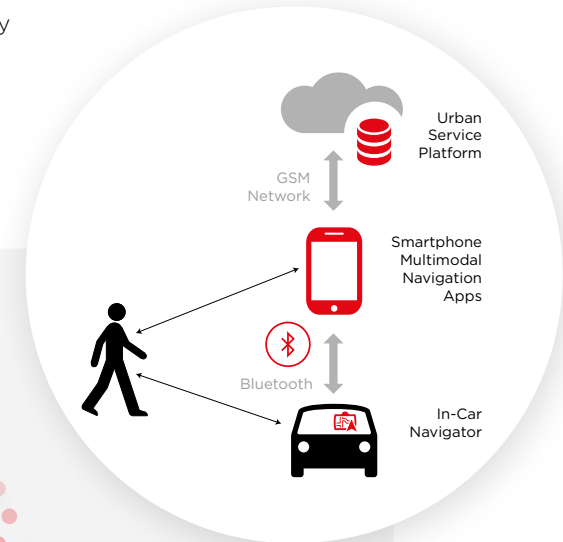
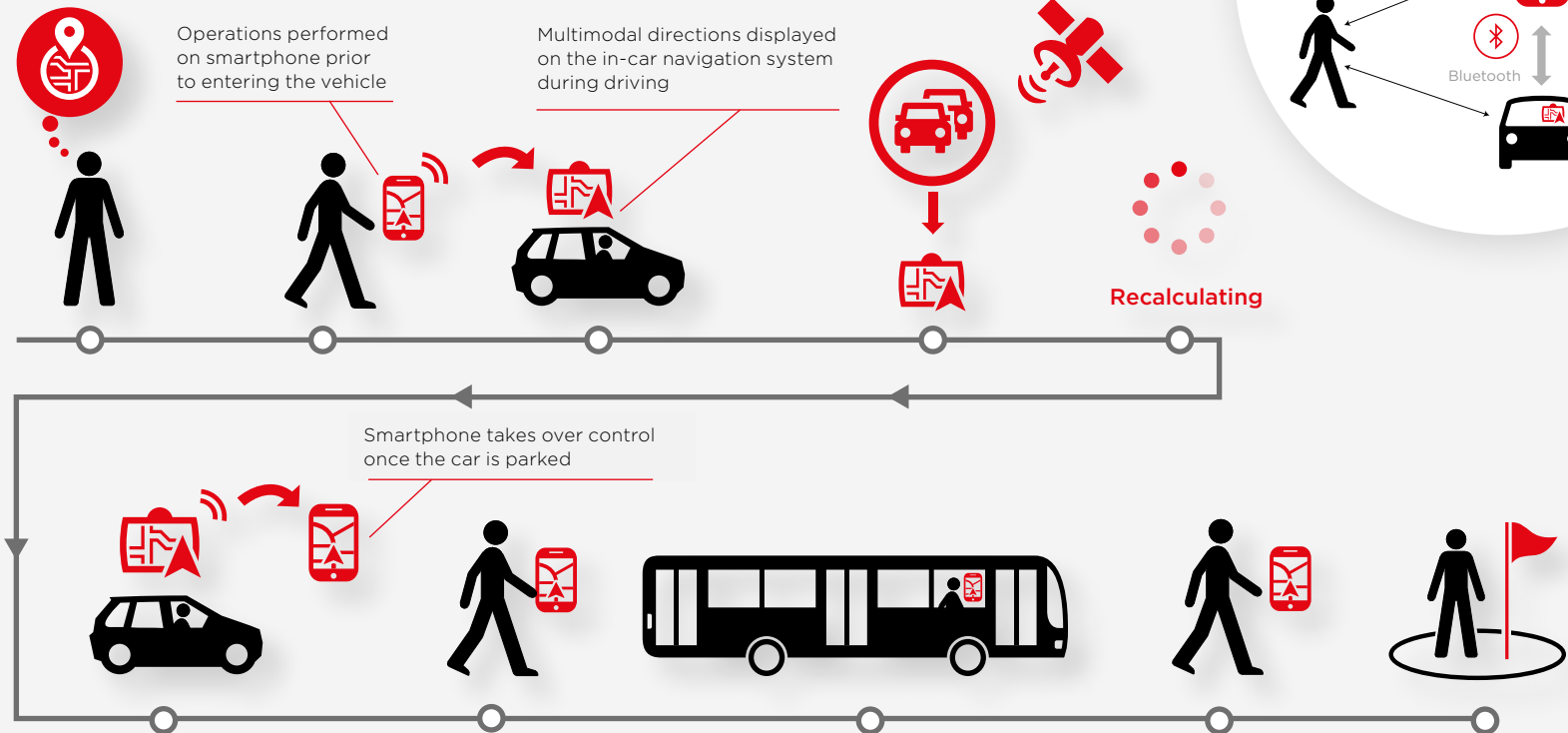
Cities are key drivers for this development as carmakers will only start to integrate multimodal mobility and dynamic carpooling services once they are convinced that interoperable solutions have been deployed by a large number of cities.

We therefore recommend a two-step process:

- A consortium of European car-makers should review, discuss and modify the OPTICITIES proposal in order to create a standard
- European regulators should make this standard a recommendation for the cities and the car industry

This action will foster the development of dynamic carpooling services and support the full integration of cars into cities' multimodal mobility offer.

#### SERVICE CONTINUITY SMARTPHONE-VEHICLE PRINCIPLE



**REPLICATION POTENTIAL**

**Easiness of replication**

**Impact on mobility**

# REAL-TIME CAR POOLING

## FOCUS AND OBJECTIVES

Carpooling is a relevant solution with great potential for the mobility issues faced by large cities:

- It generates significant CO<sub>2</sub> savings
- Limited offer of public transport services in peri-urban areas leads to high ratios of individual car use
- Individual car occupancy rate remains limited
- The massive penetration of smartphones eases the match-making among users.

A dynamic urban carpooling app was developed and tested within the framework of the project. The objective was to test the conditions under which carpooling can be integrated into the urban mobility chain.



## Situation and challenges

Short-distance dynamic daily carpooling, in urban or peri-urban areas currently struggles to find its place. Numerous attempts to occupy this market gap failed to define robust models.

For most projects, the pitfall resides in the reach of the critical mass of users. Indeed, this critical mass, and more specifically the time period in which it is reached, is absolutely crucial for such a service. If not achieved in the early phase of the service, the number of users will irremediably decrease.

The economic model is another challenge, as the traditional commission-based model is not effective for short-distance trips. A study on the business model has been conducted in parallel to this test.

## Approach

The tested system is a carpooling offer located on corridors with little public transport service, ensuring connections between employment and living areas. The corridor logic tries to tackle the critical mass issue by guaranteeing a sufficient trip frequency.

The service is offered between pre-defined points, some of which are chosen to be in connection with the public transport network.

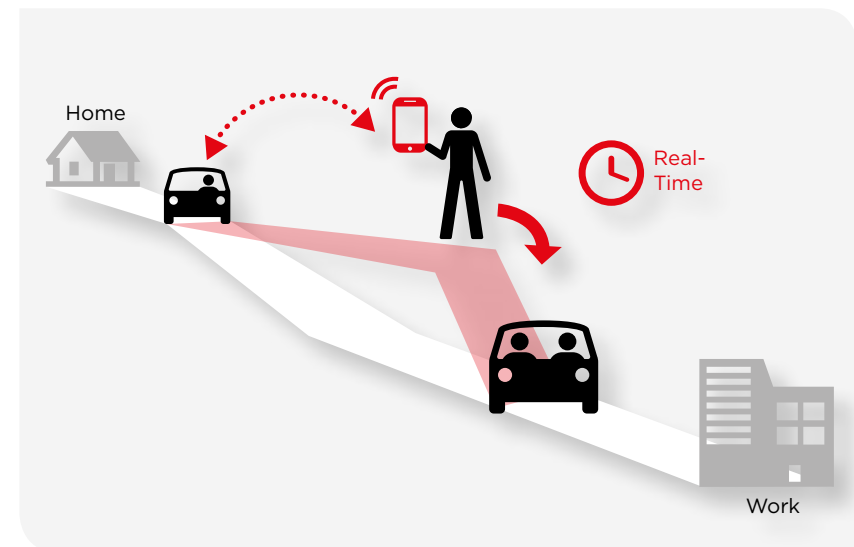
The system architecture is based on two elements: a carpooling app developed for the project; connected with the upgraded multimodal navigator in order to enable the integration and calculations of carpooling solutions.

## Results

Main features of the tested service:

- **Service to employment areas:** to ensure strong daily traffic potential
- **Multimodal:** the carpooling offer is integrated into the multimodal navigator OPTYMOD
- **Real-time:** user location is used to evaluate the estimated time of arrival
- **Stop selection:** drivers select the stops they wish to serve,
- **100% mobile:** service runs through the mobile app.

## REAL-TIME CAR POOLING PRINCIPLE



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- **Last minute:** booking of a trip is possible until the driver's departure
- **Compensation:** a voucher-based compensation model for the participants was chosen.

Recruitment of participants was made possible by in-company incentives and a communication campaign supported by companies' point men. The system was tested on a panel of 150 participants.

The experiment's assessment was completed by questionnaires and focus groups:

- Recruitment (pre-registration) at a too early stage is not judicious. Indeed the transformation rate (pre-registration → app download) is weak
- The classic obstacles (confidence, way back, etc.) are only slightly reduced by the app, which continues to be perceived as a classic carpooling app
- Communication must be public and the support of a well-known brand is essential

- Financial commitment (compensation using vouchers) is delicate. Choosing the participation thresholds before the experiment is difficult
- The manual triggering of many steps (i.e.: "I leave", "I am at the meeting point", etc.) is an obstacle and has not been respected in practice
- The impossibility of adding stops has been emphasized by several drivers.

#### Lessons learnt

##### Service

- The system must allow drivers to personalise their itinerary
- Offering reliability is critical for passengers, particularly when no public transport provides for the return journey.

##### Technical aspects

- Use of the GTFS standard is a pertinent solution
- Service must be accessible through a single application
- Real-time information must focus on map visualisation of drivers' and passenger locations.

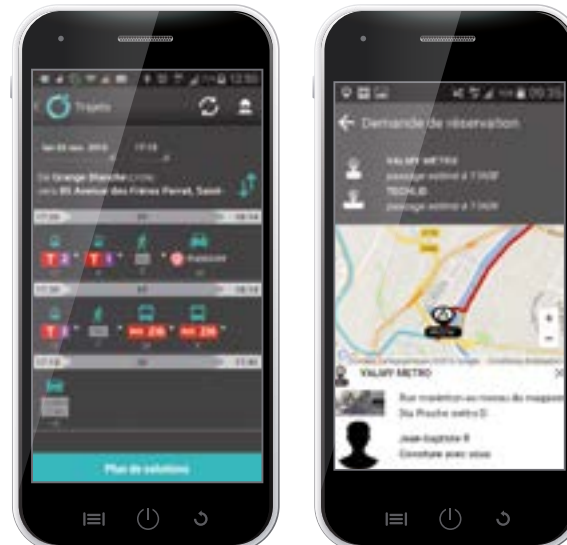
##### General

- Unfinished or faulty products are sanctioned by users
- A mixed business model should combine compensation for the drivers and payment by the passengers.

#### MAP OF THE PROPOSED STOPS



#### CAR POOLING OFFER INTEGRATED INTO THE TRAVEL PLANNER



#### REPLICATION POTENTIAL

  
**Easiness of replication**

  
**Impact on mobility**

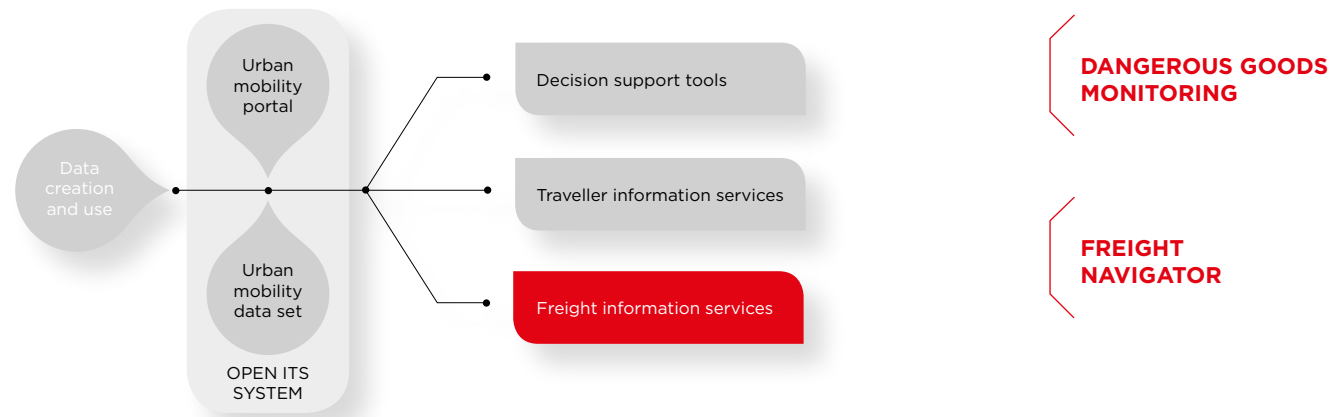




# FREIGHT INFORMATION SERVICES

## [ OBJECTIVES ]

- Develop and prepare the implementation and tests of dedicated truck services
- Minimise the impact of dangerous goods and oversized vehicles on daily city life and infrastructure
- Test complex innovative solutions that enable proactive management of freight road traffic



# DANGEROUS GOODS MONITORING

## FOCUS AND OBJECTIVES

Dangerous goods and oversized (incl. overweight) vehicles are one of the most important issues regarding the optimisation of citizen mobility and freight management.

One of the main challenges is to minimize the impact of dangerous goods and oversized vehicles on daily city life and infrastructure.

Neurosoft's objective in Wrocław city is to develop software to bring quality to dangerous goods handling and oversized vehicle management.



## Situation and challenges

The growing volume of freight transport causes damage to road infrastructure and also creates traffic management control and safety issues. Overweight vehicles accelerate bridge damages and pavement fatigue of road surface whilst overweight vehicles can cause transport disruption through collisions with bridges.

The growing number of vehicles in the city of Wrocław creates environmental and social concerns.

The excessive road traffic has a significant impact on noise and air quality levels in cities. Road traffic is the main source of noise in Wrocław. The chart below shows the total number of people in Wrocław exposed to traffic noise over a twenty four hour period.

The chart indicates that at least 37% of Wrocław citizens are exposed to road noise levels above 55 dB every day, which can affect people both, physiologically and psychologically and seriously influence their well-being.

## Approach

This project is designed to support drivers' decision process. It provides specific route advices for vehicles carrying dangerous goods or vehicles with non-standard dimensions, weight and height.

This service aims to avoid dangerous cargo traffic into specific areas (residential districts, tunnels, public safety zones) and to reduce local road infrastructure damage caused by overloaded vehicles.

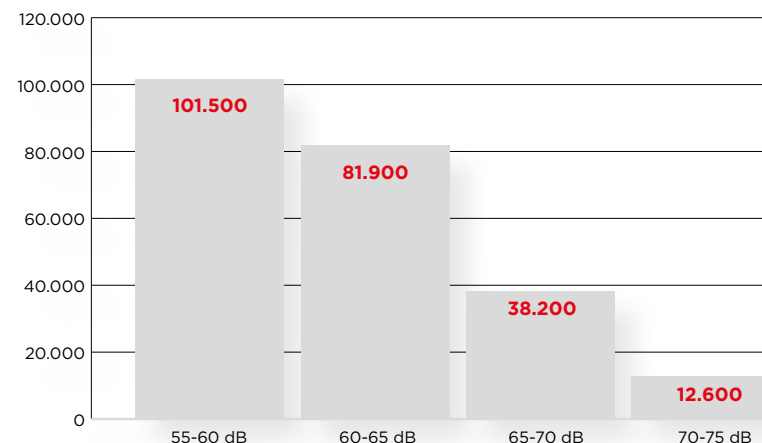
The idea is to handle requests from registered users (vehicle owner/

truck drivers), which are recognised at the entrance point of the city by a measurement point.

Consequently, the central system services create a "current passing" status, through the city transportation network: a specific itinerary is generated considering current network situation and vehicle parameters (weight, height, ADR).

The central system monitors the user's position and provides a new itinerary when the driver changes course or if a sudden event occurs (such as traffic disruption or any significant incident).

NUMBER OF PEOPLE EXPOSED TO TRAFFIC NOISE IN WROCLAW



## Results

The first results from the Wroclaw demo showed that truck drivers used navigation as a driving assistant in getting to the destination.

The navigation system is rated as correct. It is easy to use and ensures a full understanding of routing. Passing the city is no longer a matter of stress for drivers with oversized trucks or dangerous goods. The central system as well as the navigation tool needs constant development and upgrading.

## Lessons learnt

The results of the tests conducted before further implementation in other cities are:

- A better quality of communication
- More reliability of system components
- More collaboration between stakeholders.

From the technical point of view, the most important issue is the communication between all system components. There is a strong need for a reliable, constant connection between the urban ITS centre and the central navigation system. Also the reliability of the measurement points out that infrastructure plays a key role. According to the experience gained while implementing the

service for the Wroclaw demo site, an extensive administration work is not necessary to reach a high quality of service.

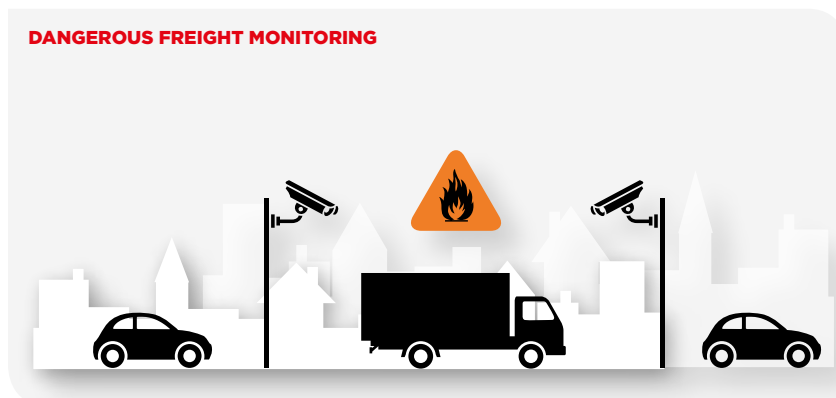
Please note that the system has a defined data format. Data sources must comply with these specifications no matter if the realization of the project includes the cooperation between two different entities: public sector (city of Wroclaw) and private (Neurosoft).

This implementation does not require any changes or adjustments and there is no need to add new elements.

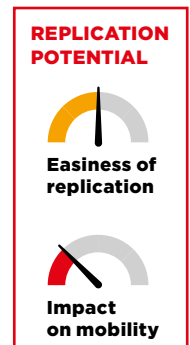
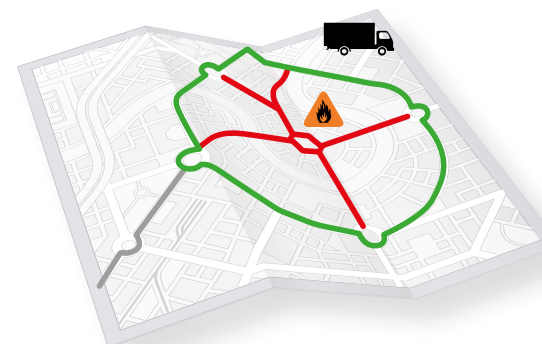
The system is complete and ready to use in the cities with the operating ITS systems.

However, further development of the service is possible and recommendable: for example adding more data such as weather conditions, roadside air and noise quality levels and other significant information to develop an active traffic management system.

The navigation may be improved by including up-to-date information relevant to the freight haulage industry such as location and contact details for industrial estates, airports, parking restrictions and real-time availability, etc. The further step could be the extension of the service from local to national level, and subsequently, to international level.



## INNER CITY TRAFFIC EXCLUSION





# FREIGHT NAVIGATOR

## FOCUS AND OBJECTIVES

Currently cities manage traffic congestion by reacting to incidents and events as they happen. With increasing demand on the urban road network we recognise the need to apply management strategies more quickly to achieve maximum benefit.

Our objective has been to test complex, innovative solutions that enable proactive management of road traffic by the integration of predictive traffic information to the existing traffic control centres.

Our approach to traffic prediction resulted in focussing on methodologies based on the use of micro-simulation modelling and predictive algorithms designed to predict traffic conditions up to 60 minutes in advance based on current traffic demand.

This effectively provides traffic managers with a decision support tool that allows them to manage their strategic road network more effectively.

## Situation and challenges

The challenge was to utilise the decision support tool to demonstrate the ability to deliver journey time reliability for freight vehicles on a specific route based on the introduction of traffic prediction into the TMS.

The aim is to optimise journey time for freight vehicles within a defined urban area that also takes into account existing designated freight routes and to utilise the Urban Mobility Portal to deliver driver information as a proof of concept based on the notification of traffic congestion alerts based on the output of the decision support tool.

## Approach

The approach taken is to provide a plug in service to the TMC Management and Decision Support Tool system that is applied to an extension of a DST route that is optimised to provide journey time reliability for freight vehicles.

## DRIVER ASSISTANCE APP



The service is applied to specific signalised junctions that utilise existing vehicle detection to classify freight vehicles and provide priority measures that prevent the vehicle from making unnecessary stops with the aim to provide consistent journey times between key junctions.

This is also linked to adopting different priorities at traffic signals dependent upon demand and time of day.

This approach is designed to encourage freight traffic to use strategic routes and discourage the use of unsuitable roads; benefit delivery times and schedules; reduce congestion and improve air quality by minimising queuing traffic.

## Results

The initial results are focussed on delivering information on congestion by utilising the Urban Mobility Portal to deliver enhanced driver information and notifications via a service App as a proof of concept. This can use either an existing driver assistance App and existing user base; or by developing a demonstration App as proof of concept



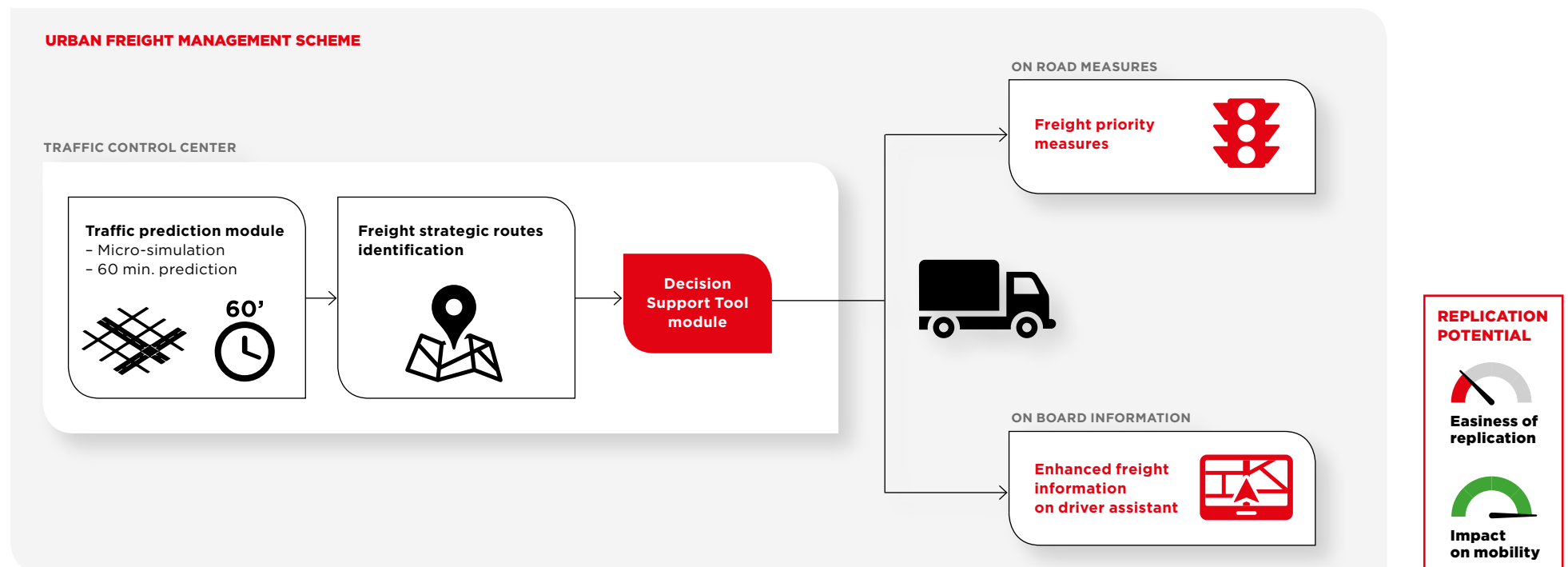


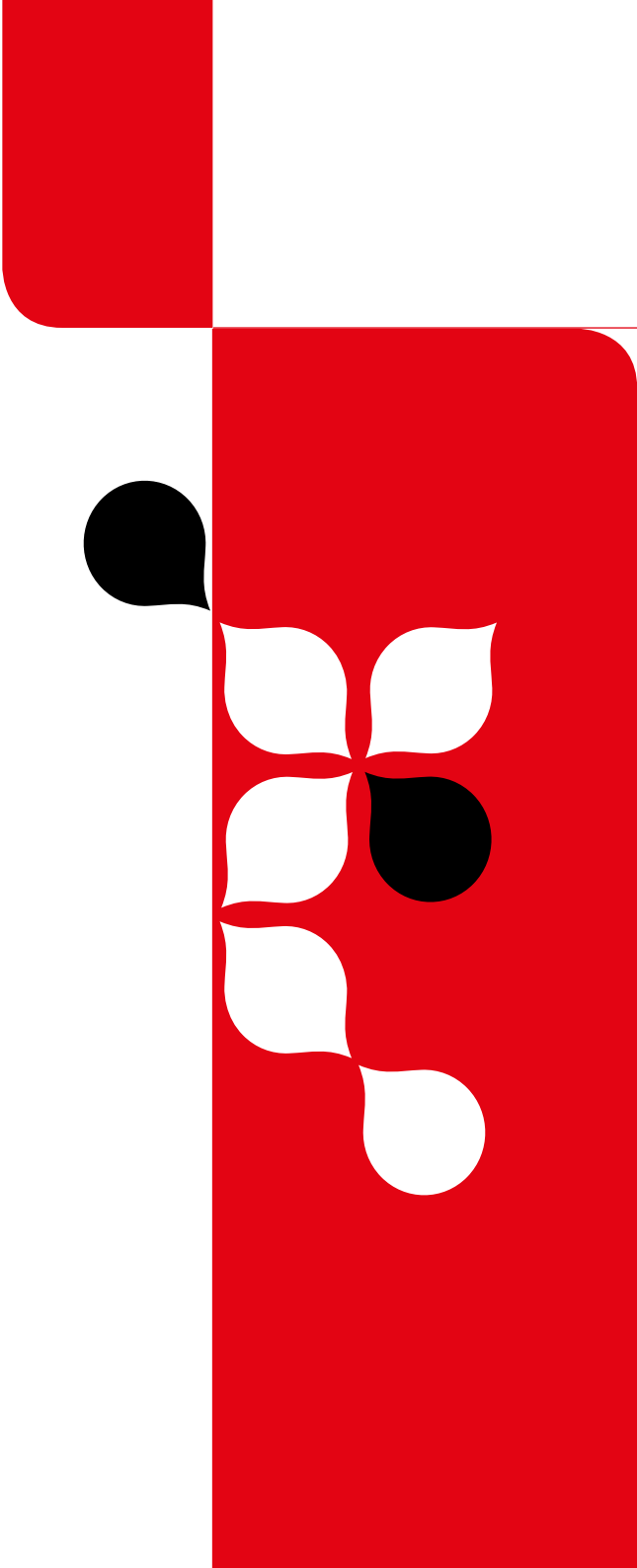
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### Lessons learnt

The implementation of traffic prediction service is challenging and reliant on high quality data from the road network. Therefore, data quantity and quality needs to be high for both historic and real time data.

The service is highly dependent upon the maintenance of the on-street network; staff training with regard to using and developing the developed service and the development of internal procedures to create and develop traffic management strategies.







# EVALUATION

## [ OBJECTIVES ]

- Support the design of the tools developed in the technical activities, allowing for a continuous monitoring during the project, thus enhancing its quality
- Evaluation, according to a common and standardised approach, of the performance and the efficiency of the tools, but also in terms of Human Machine Interface
- Support public decision makers in the assessment of public policies

**PRE-DESIGN  
& EVALUATION**

**TRANSPORT POLICIES  
IN URBAN AREAS**

# PRE-DESIGN AND EVALUATION

## FOCUS AND OBJECTIVES

The evaluation of the effects of technological tools on society, environment and economy focuses on assessing whether the designed tools providing integrated mobility information are effectively useful to facilitate a positive modal shift, thus enhancing the use of sustainable transport modes (PT and soft modes), both for passengers and freight, and reducing travel cost, time and environmental pollution.



## Situation and challenges

The assessment of information reliability and of the functioning of the 13 different tools (Decision Support Tools-DST, Traveller Information System-TIS and Freight Information System-FIS) developed for six european cities:

- Birmingham: two DST and one FIS
- Gothenburg: two DST and one TIS
- Lyon: one DST and two TIS
- Madrid: one DST and one TIS
- Torino: one DST and one TIS
- Wroclaw: one FIS.

The use of a common and harmonised methodology allowing the geographical and cultural comparison among the six cities.

## Approach

A project-long evaluation approach was defined:

- The ex-ante phase pointed out the requirements desired by the potential users of the different tools
- The in-itinere phase carried out during the test reported all bugs and malfunctioning of the tools
- The ex-post phase synthesized the experimentations' outcomes, with a special focus on the design of a Business Model for the future maintenance of the tools.

The evaluation methodology entailed the use of a mixed approach, combining both the qualitative (focus groups and interviews) and the quantitative (questionnaires) investigation methods.

The evaluation process involved different groups of experts for the DST (policy makers, technicians and transport operators), truck drivers for the FIS, and of a panel of citizens for the TIS.

## Results

The questionnaires designed for the TIS allowed to measure:

- The psycho-social factors
- The transport related values (cost, speed, comfort, pleasure (I like this mode of transport), flexibility, independence, respect towards the environment and reliability of travel time)
- The home location (divided into urban, suburban and rural).

The Exploratory Factor analysis found two factors influencing the choice of transport mode for the users' most frequent trip:

- **Utilitarian:** Speed, flexibility and independence, reliability of the travel time, comfort
- **Convenience:** Cost, pleasure, respect towards the environment.

A cluster analysis based on the factors showed three clusters of users:

- **Neo-Luddites Opportunists:** they follow a desire for a simple life where technological tools are restrained to a minimum. They are not willing to use the real-time multimodal navigator
- **Hedonic Techy Ecologists:** they are in favour of technological use and show a higher score on the Convenience transport value. They

prefer cheap and pleasant trips rather than fast and efficient ones. They expect technology to solve transport-related problems, and are aware of the need to pay for a service such as the multimodal navigator. They can represent the main source of revenue in a business model assessment

- **Neoclassical Agents:** they show a higher score on the Utilitarian transport related value. They also show a low score on the measure of attitude towards the environment.

Even if they may benefit from the multimodal navigator, it is unlikely that they will shift from their most favoured mode until economic constraints force them to do so.

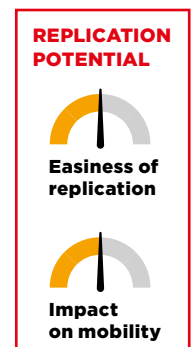
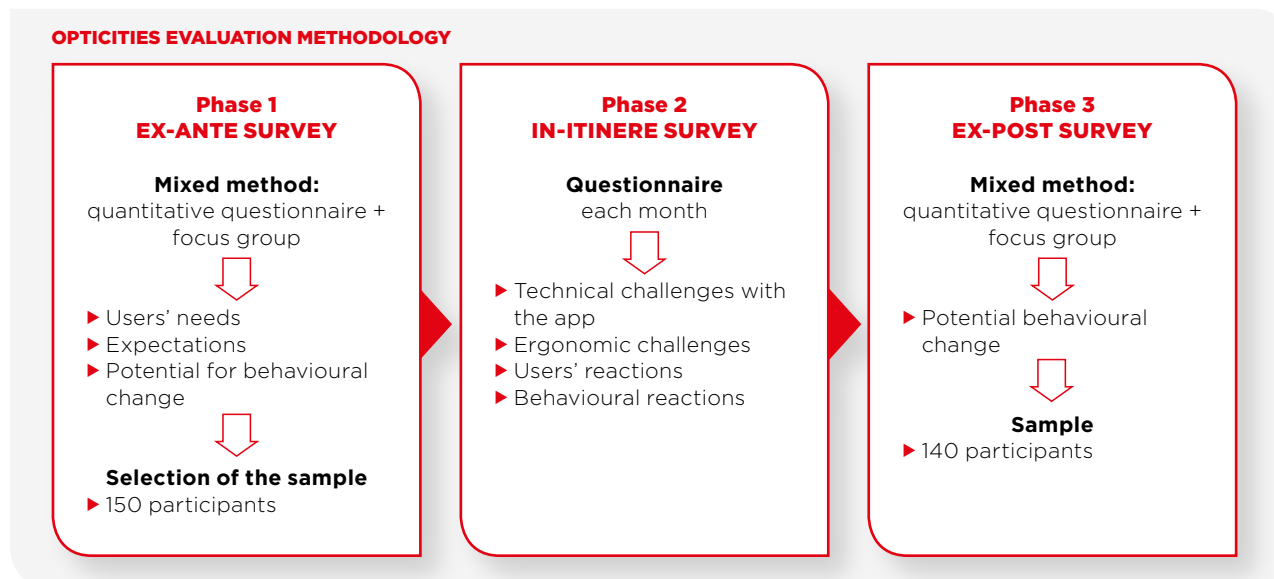
Concerning the DST, the wide diversity among the six cities makes the comparison difficult. However, in each city an important advancement in terms of current transport planning and mobility management have shown the high potential of the use of multimodal data to better understand the mobility patterns.

### Lessons learnt

The evaluation process was very complex and challenging, requiring comparison between the effects of different categories of tools in different territorial contexts.

Obtaining comparable results was hampered by the difficulty in implementing the same questionnaires in the 6 cities.

The methodology and the mixed method used have however shown a big potential in analysing user behaviour, understanding how much the developed tools will be used by the travellers and, above all, if the users are willing to pay for such devices.



# TRANSPORT POLICIES IN URBAN AREAS

## FOCUS AND OBJECTIVES

In a large number of European cities, car mobility no longer seems to be a priority but represents in fact the bulk of transportation. This new trend is a challenge for the evaluation process because (former) assessment tools directly inherited from cost benefit analysis give an important role to individual time gains i.e. speed gains. But speed is no more on the top of the agenda and even if time use remains a crucial issue, a new approach of collective interest is necessary.

## Situation and challenges

The challenge currently faced by public decision makers is not only to assess public policies against time gains or losses, but also to keep under control the impacts of transport on land use. The goal is to integrate new assessment tools based on accessibility measurement. Accessibility maps help to understand the recent new priorities and the coming challenges of public policies.

## Approach

We propose to measure and illustrate accessibility in the Lyon area and to analyse results in the lights of transport demand. The aim is to represent a current panorama highlighting possible instead of a mere vision of congestion points. A prospective simulation is then developed to assess travel demand (by car and public transport) in 2030. First, a business-as-usual (BaU) scenario is made to integrate changes in population and job levels and locations but also new transport infrastructures. Another scenario considers new pricing policies.

Accessibility is a central concept in the context of evaluating transport projects for urban environments. This concept thereby goes beyond the framework of the transport system and its purely temporal dimension, associating it with a spatial dimension. Accessibility should reflect the spatial organisation and the quality of the transport system that provide individuals with the opportunity to participate in activities located in different parts of the region. Accessibility impacts of transport projects are assessed using the modelling platform for planning sustainable mobility MOSART.

## Results

Both the current situation and the BaU scenario for 2030 highlight relatively uncongested networks and accessibility is not impacted. In 2030, BaU scenario accessibility increases even with a population and traffic rise, because of the number of job growth. Nevertheless when applying a price increase (doubling either car or public transport costs), networks not impacted by the price variation are quickly congested. Cross-town expressways or bypasses are primarily impacted for the road network and central stations for public transport network. A price variation has a fairly limited impact on accessibility by car for car users coming from central areas, where accessibility remains with a high level. Nevertheless for those coming from beyond the first ring, impact is felt with a travel time variation of around 10 minutes at least.



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## Lessons learnt

### Congestion and accessibility

Road congestion affects accessibility by increasing the travel time or reducing the number of opportunities available for a given travel time. But congestion threshold can vary according to speed-flow curve and the traffic management system. Moreover, travel time increase can be offset by an increase of opportunities or by a better use of time thanks to smart devices.

### Car accessibility is cost sensitive

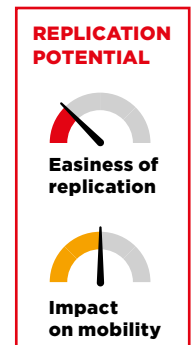
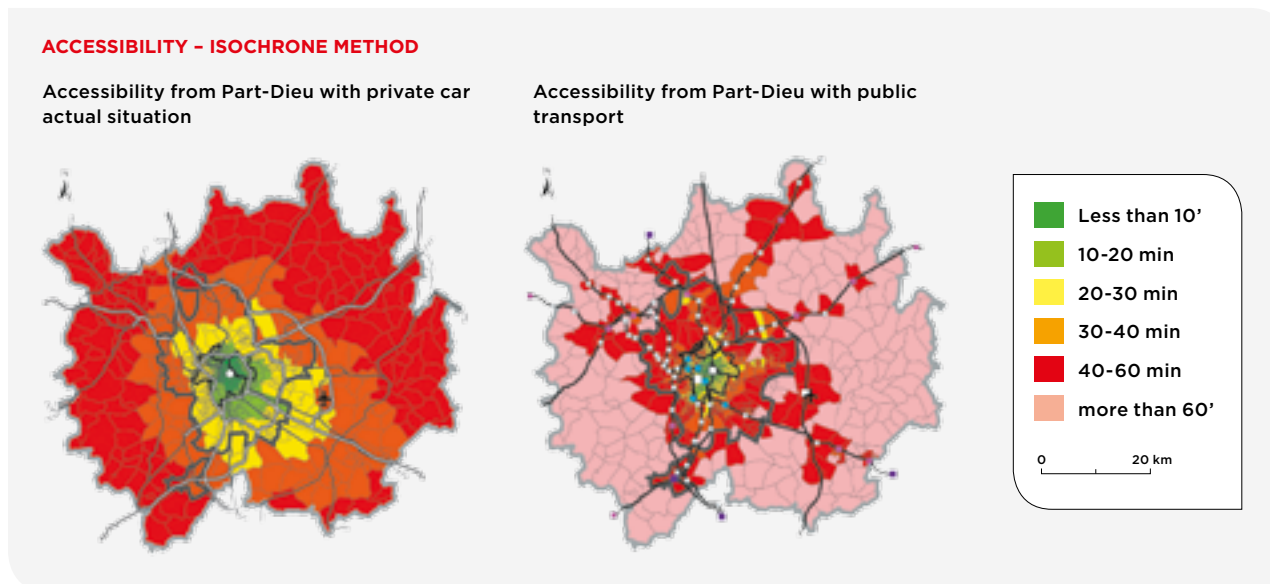
Doubling the cost of car use leads to a much lower accessibility for people living in the outskirts of the city. But it is not the case for people living in the denser part of the agglomeration. On the other hand a car price decrease (-50%) gives a new lease of life to car accessibility. It is exactly the present situation due the low price of gasoline and the reduction of fuel consumption of new cars.

### Accessibility and spatial development

Individual perception of accessibility is a key element to understand impact of mobility costs on travel behaviours. In relation with the sustainable mobility paradigm, mobility in urban areas is today clearly linked to the ability of public transport systems to improve accessibility to dense urban areas, rich in jobs, shops, houses, activities and other urban amenities.

But what if the generalised cost of car mobility, including monetary cost and travel time, is lower and lower for car mobility? The result will be, as during the last decades, a support for urban sprawl and a urban dynamic totally different from the objectives of public policies

One of the main challenges in that field is to bring appropriate instruments of accessibility measurement and modelling into practice. A travel cost sensitivity parameter can be drawn from accessibility indicators to highlight socio-economic disparities to access urban opportunities.



# OPTICITIES'

ENHANCING SMART MOBILITY

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# PROJECT PARTNERS

## Project coordinator

- Métropole de Lyon

## Cities

- Ayuntamiento de Madrid
- Città di Torino
- Göteborgs Stad
- Birmingham City Council
- Wrocław Miasto

## Industry and services providers

- Cityway
- CRTM (Consortio Regional de Transportes de Madrid)
- CSI Piemonte
- Hacon
- ICCA
- Neurosoft
- SPIE
- Volvo Technology
- 5T (Traffic Transport Travellers Ticketing Torino)

## Research academics

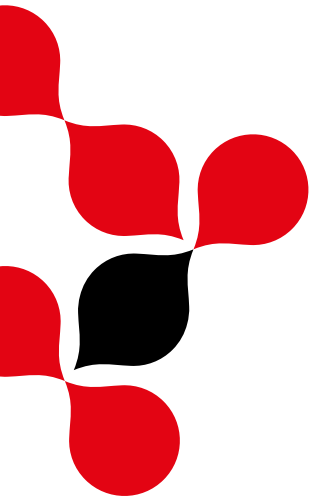
- Universidad Politécnica de Madrid
- Politecnico di Torino
- Chalmers University of Technology
- Institut VEDECOM
- CNRS (Centre National de la Recherche Scientifique)

## European networks

- EUROCITIES
- ERTICO
- UITP (International Association of Public Transport)

## Consulting

- Algoé Consultants
- Helmut Berends





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**OPTICITIES**  
ENHANCING SMART MOBILITY

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