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START UP FOR DEVELOPMENT

MODULE 4

SMART TRANSPORT

Project Code: 2020-1-ES01-KA204-082611

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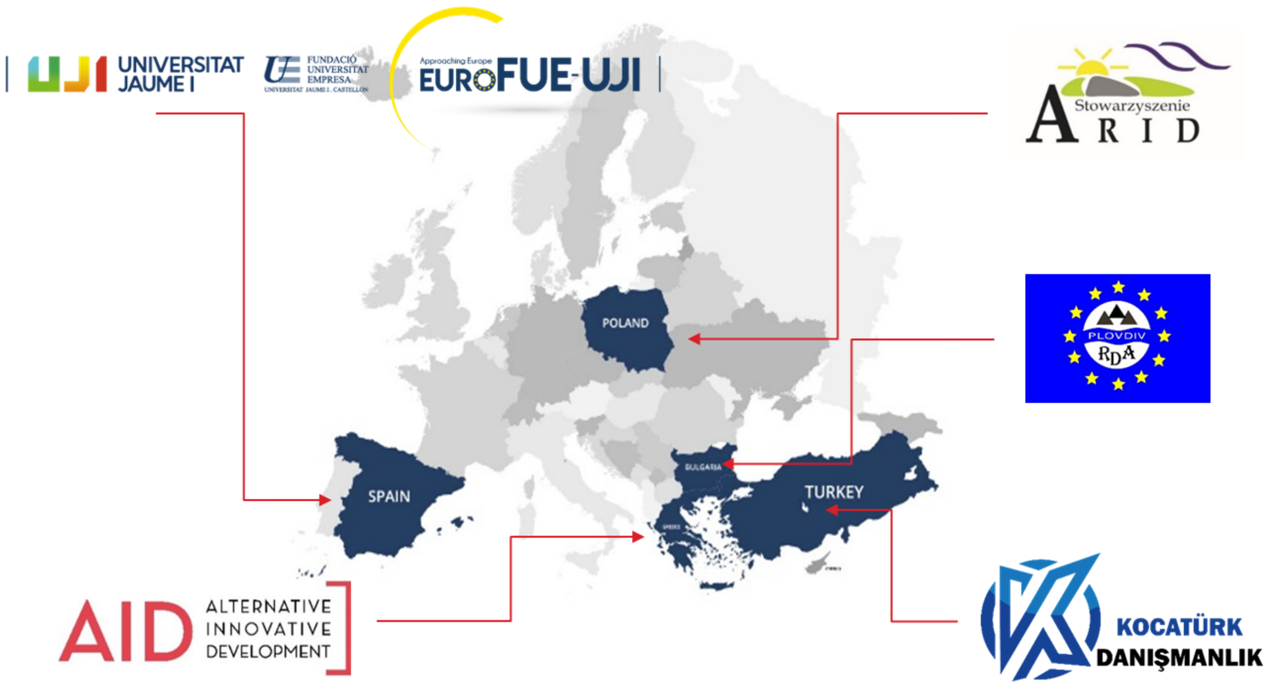

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APPLICANT COORDINATOR: FUNDACIÓN UNIVERSITAT JAUME I-EMPRESA (ES)

PROJECT PARTNERS:

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ENALLAKTIKI KAINOTOMA ANAPTYXI ASTIKI MI KERDOSKOPIKI ETAIREIA (GR)

CONTENT MAP:

ANNOTATION AND LEARNING GOALS:

The general objective of the smart-transport module within the introductory course to the concept of smart cities and towns is to provide students with a specific chapter that allows them to learn about the applications of the smart concept in the field of urban transport.

To this end, and having already known and understood the smart concept through the previous study of the introductory module, the student will find in this fourth module of the course, Urban Transport, the justification of the convenience of using smart techniques for the design and management of transport in cities and towns from a sustainability perspective, in accordance with the recommendations of the European Commission.

The educational objective of the module is for students to be able to develop a process of analysis of urban transport problems, to know the main techniques available and the information to be extracted from their application. Also, the objectives to be set and to assess their implementation. All this from a perspective of urban environmental, social and economic sustainability.

EXPECTED LEARNING OUTCOMES:

At the end of the study of the module and after having carried out the activities included in it, the student will be able to acquire the following knowledge, skills and competences:

Knowledge:

- To recognise the mobility function within the urban ecosystem.
- To understand the relationship between urban mobility function and sustainability
- To identify the main environmental problems related to urban transport.
- To set up a problem diagnosis and evaluation scheme.
- To understand the main techniques used: ITS, GIS, mobility surveys and mobility indicators.
- To understand the types of results to be obtained from the use of the techniques and their application in the formulation of objectives.
- To learn about a case study of smart-transport applied to a medium-sized city.

Skills:

- To recognise unsustainable situations related to the mobility function within the urban ecosystem.
- To diagnose potential urban transport problems
- To provide knowledge for target setting
- To criticise and correct adopted solutions
- Independent working skills

Competences:

- Competences for learning new techniques
- Professional competences related to urban transport
- Independence and responsibility

FORMS AND METHODS OF WORK

The methods used in this module are those recommended by the project co-ordinating group.

The working methods are:

- Lecture with discussion (online/offline)
- Training seminars (online/offline)
- Self-study (online/offline)
- Interactive activities
- Case study

GENERAL MODULE OVERVIEW

The module is focusing on the relationship between the mobility function of the city ecosystem and sustainability in its triple environmental, social and economic dimension.

UNIT 1. URBAN TRANSPORT INFRASTRUCTURES AND ELEMENTS. URBAN SUSTAINABILITY

What are smart cities?

- Cities using technological solutions to improve the management of the urban environment.
- A smart city is a place where traditional networks and services are made more efficient with the use of digital and telecommunication technologies for the benefit of its inhabitants and business. A smart city goes beyond the use of information and communication technologies (ICT) for better resource use and less emissions. It means striving for sustainability through smarter urban transport networks, upgraded water supply and waste disposal facilities, and more efficient ways to light and heat buildings.

YouTube

[CALD TALK - Sustainable Transport]

1.1. Basic concepts of urban sustainability

Urban areas and their transport systems in particular play an important role in meeting the objectives of the EU Sustainable Development Strategy. It is in these areas that the meeting of the environmental, economic and social dimensions is most evident:

- Environmental dimension, contributing to the protection of the environment and the health of citizens, reducing the environmental impacts of transport, contributing to the reduction of greenhouse gas (GHG) emissions and optimising the use of non-renewable resources, especially energy resources.

- Social dimension, providing adequate accessibility conditions for citizens to labour markets, goods and services, favouring social and territorial equity and healthier transport modes.
- Economic dimension, efficiently meeting the mobility needs arising from economic activities, thus promoting economic development and competitiveness.

1.2. Sustainable mobility

The mobility function of the city ecosystem can be defined as a matrix of flows of people, goods and services circulating on a network formed by transport infrastructures where the different factors of the system are interrelated by means of vehicles and static elements.

From the point of view of sustainability, the main objectives to be considered in the implementation of policies based on the use of information and communication technologies applied to the management of urban transport (Smart-transport) should be:

- Environmental impact, reduction of emissions from vehicle use.
- Social impact, strengthening of social and territorial cohesion.
- Economic impact, improving the efficiency and quality of services.

The main environmental problems related to transport in cities include:

Air quality	Particulate matter Photochemical ozone formation Acidification
Greenhouse Gas Emissions (GHG)	Climate change
Urban sprawl	Land use

Solutions have to be tailor-made for each city and based on the information obtained from the consultation of its citizens and all stakeholders together with the results of appropriate technical analyses.

Thus, sustainable mobility is defined as the promotion of the use of public transport and non-motorised modes, in compliance with European Directives. A sustainable approach to urban planning involves linking urban development and facilities to the promotion of sustainable transport.

Sustainable means of transport are those which, compared to the car, have a lower environmental impact, consume fewer resources and reduce social conflicts. This includes, for example, walking, cycling and collective means of transport when they are used with a sufficient level of occupancy.

In relation to transport, the lines of action to be established in order to improve the sustainability indices of cities through the implementation of techniques based on the smart-city concept are:

- Development of sustainable mobility plans aimed at promoting the use of vehicles with low CO_2 emissions and low energy consumption, reducing the level of GHG in local terms, contributing to reducing air and noise pollution, improving the health of citizens and combating obesity.
- Development of road infrastructure, avoiding solutions based on increasing capacity and creating new urban roads to solve congestion problems. Solutions should be based on the promotion of sustainable modes of transport, quality public transport, cycling and walking. Existing and future road capacity should be dedicated to these sustainable transport modes.
- Integration of urban and inter-urban transport systems, intelligent traffic management systems allow an efficient link between the various modes of transport which, together with a peripheral parking scheme, help to avoid congestion on urban roads.
- Organisation of public authority action in the city through land reclamation operations and degraded infrastructures.

In conclusion, the main objectives related to sustainable mobility and which, from the perspective of a Smart-city, should be studied and remedied by appropriate techniques and procedures, are as follows:

- Reduce dependence on cars and on vehicles with combustion engines in general.
- Reduce the impacts of motorised travel.
- Avoid the proliferation and expansion of car-dependent spaces.
- Increase the possibilities of sustainable means of transport by promoting conditions that allow citizens to walk, cycle or use public transport in safety and comfort.
- Reconstructing the concept of proximity as an urban value, favouring daily life without long-distance journeys
- Reclaiming public space, streets and squares, as a meeting place.
- Increasing the autonomy of social groups without access to cars: children, young people, women, people with disabilities, people with low income, the elderly.

UNIT 2: IMPACTS ASSOCIATED WITH URBAN TRANSPORT

This unit will focus on urban mobility solutions and the outcome of their environmental assessment: climate change and particulate matter.

2.1. Modern City and Smart-Transport

80% of the EU population lives in urban areas. Cities occupy 1% of the territory and account for 75% of energy consumption and 80% of greenhouse gas emissions. In addition, 85% of Europe's GDP is produced in cities.

From a demographic perspective, the process of urbanisation of the world's population is an irreversible trend. The citizens living in these centres, regardless of their size, require mobility, which has led to the development of complex and environmentally, socially and economically inefficient transport systems.

Citizens demand solutions to their transport problems that guarantee the movement of people and goods in a way that is economically efficient, safe, adapted to social needs and that provides smart, flexible and sustainable mobility patterns.

These mobility solutions, which require the satisfaction of citizens' demands for improved quality of life together with a guarantee of environmental, social and economic sustainability of cities and towns, define the concept of smart-transport.

The construction of a city model with a smart-transport system requires participatory planning processes that take into account the particular urban patterns of each city or town, its demographic dynamics, and its urban and territorial processes from an integrated approach. For the success of these processes, the coordination, collaboration and cooperation of the Administration together with all the agents involved is essential.

YouTube

[Smart Transport Solutions]

2.2. Results of the environmental assessment of various urban transport vehicles

The results obtained from the environmental assessment of the urban performance, measured in units of person-km, of various vehicles used in passenger transport are presented below.

These results are part of a research carried out by the SOGRES-MF group of the Universitat Jaume I of Castelló (Spain) on the sustainability of urban passenger transport.The results obtained for the impact categories are presented in an organised way:

- CLIMATE CHANGE
- PARTICULATE MATTER

IMPACT CATEGORY: Climate Change	kg CO2 eq
BICYCLE	0,00052
ELCTRIC BICYCLE, LABEL-CERTIFIED ELECTRICITY	0,00140
ELECTRIC BICYCLE	0,00924
ELECTRIC SCOOTER	0,03370
TRAM	0,06950
TROLLEYBUS	0,09690
REGULAR BUS	0,09800
MOTOR SCOOTER	0,11200
CAR, ELECTRIC	0,18400
CAR, MEDIUM SIZE, NATURAL GAS, EURO 5	0,19900
CAR WITH INTERNAL COMBUSTION ENGINE	0,24600

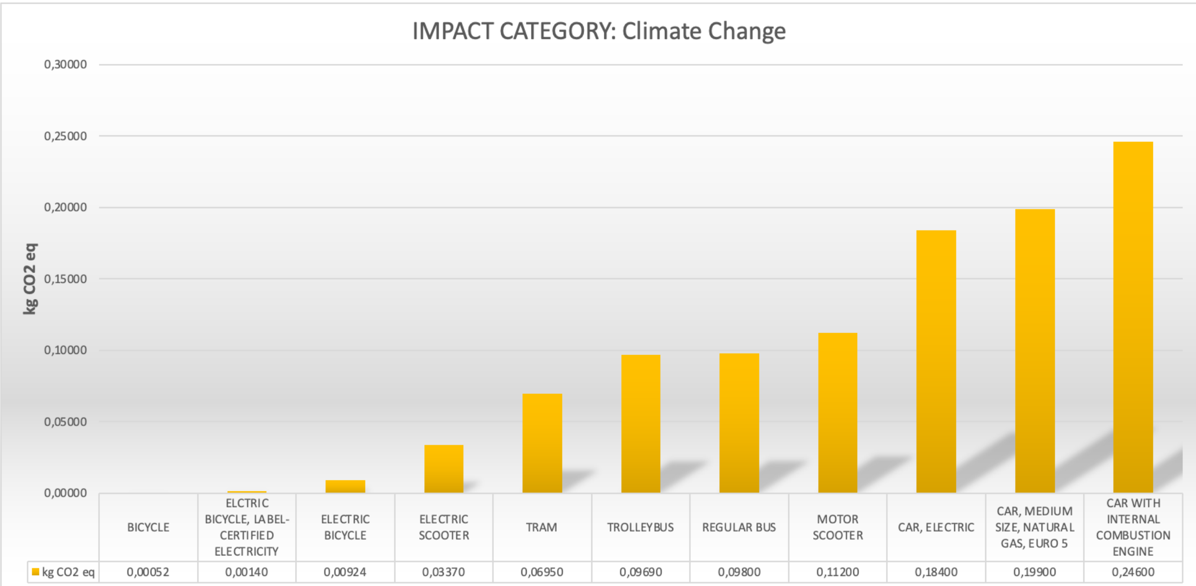

Illustration 1 Impact category: Climate change

IMPACT CATEGORY:Particulate matter	disease inc
BICYCLE	6,45E-11
ELCTRIC BICYCLE, LABEL-CERTIFIED ELECTRICITY	1,13E-10
ELECTRIC BICYCLE	4,03E-10
ELECTRIC SCOOTER	1,82E-09
TRAM	2,59E-09
CAR, MEDIUM SIZE, NATURAL GAS, EURO 5	3,91E-09
TROLLEYBUS	4,34E-09
MOTOR SCOOTER	5,06E-09
CAR, ELECTRIC	9,54E-09
REGULAR BUS	1,05E-08
CAR WITH INTERNAL COMBUSTION ENGINE	1,06E-08

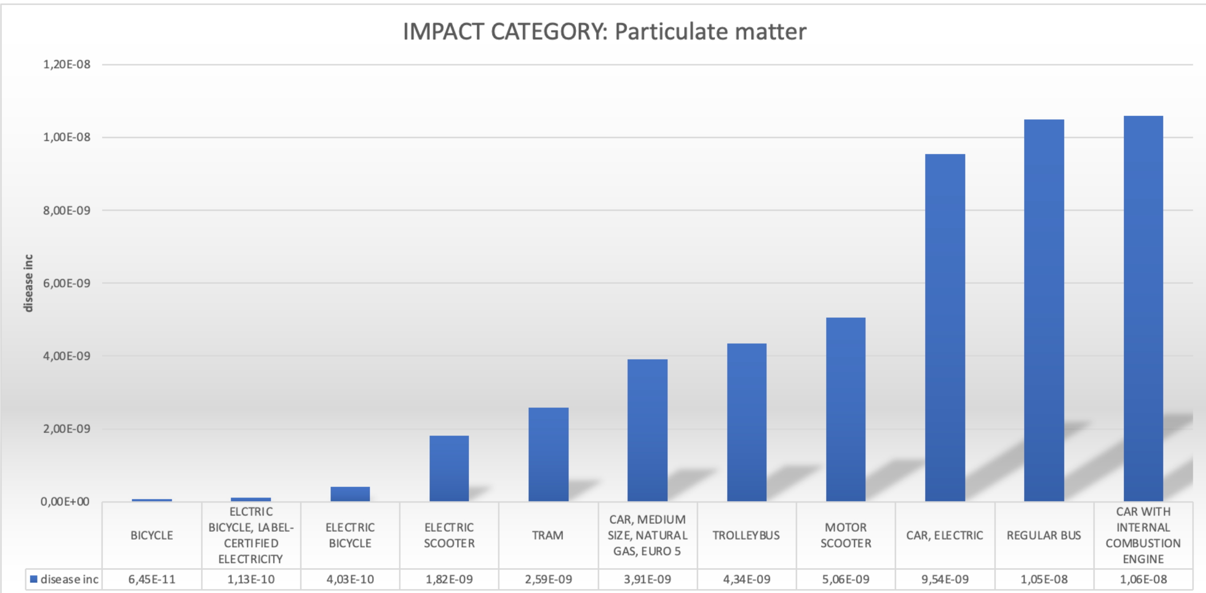

Illustration 2 Impact category: Particulate matter

UNIT 3: ANALYSIS AND MANAGEMENT TOOLS

This unit explains the diagnosis and evaluation stage. In addition, you will learn about evaluation and management tools: intelligent transport systems (ITS), geographic information systems, quantitative indicators and tools for citizen participation.

3.1. Diagnosis and evaluation

The first step in establishing sustainable urban mobility in a smart-city context should be the identification and assessment of the problem within the framework of the geographical territory of the municipality, taking into account the interrelationships established with other territorial entities and organisations. This stage should be specific to each municipality and should take into account both the size of the municipality and the surrounding conditions.

One of the fundamental aspects to be considered in the establishment of a sustainable urban mobility system should be the consultation and participation of citizens and related social actors. Data collection and processing techniques and methods based on information and communication systems help to relate the concept of traditional mobility to that of sustainable mobility.

The diagnosis and evaluation stage should include:

- To carry out a comprehensive assessment of the present and future needs and possibilities in terms of urban mobility in the municipality.
- To guarantee an integrated approach and coordinated action of the actions to be carried out within a framework of urban development.
- To have the necessary technical and financial means at the disposal of those responsible for planning.

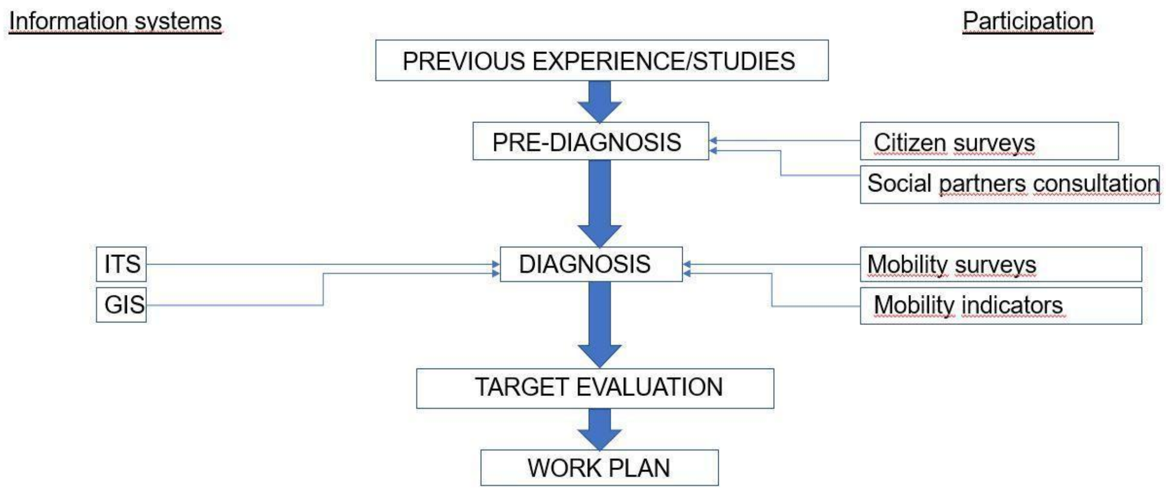

Illustration 3 Information systems

3.2. Evaluation and management tools

3.2.1. Intelligent urban transport systems

Intelligent Urban Transport Systems (ITS) are key to urban mobility planning and evaluation. ITS based-on electronics, IT and telecommunications are advanced applications that provide innovative services related to different modes of transport and traffic management that enable users to have better information and to make a more coordinated and intelligent use of transport networks.

ITS are the smart-transport concept's response to the growing demand for more sustainable urban mobility, in such a way that, in contrast to traditional solutions of increasing road and vehicle infrastructures, they provide the necessary knowledge for planning and establishing solutions that improve the effectiveness and efficiency of mobility and its safety from a sustainable perspective. The contribution of ITS is essential for developing more sustainable and efficient mobility without increasing impacts.

The architecture of an ITS consists of the conceptual design that defines the structure, behaviour and integration of a given system in the context in which it is located. Through devices, interfaces between systems, the connection and interaction between different means of communication is enabled, providing users with data on the road network, traffic data and travel data.

Road network data refers to the characteristics of the road infrastructure, including fixed traffic signs and their safety regulatory attributes.

Traffic data collects both historical and real-time information on traffic characteristics on the road network.

Travel data facilitates planning, booking and adapting travel to the reality and forecasting of situations related to both the road network and traffic, by means of multimodal information.

The priority areas of use of ITS, in this context are:

- Collection of road network, traffic and travel data for use as a planning and evaluation tool.
- Urban mobility related safety applications
- Provision of real-time traffic information services
- Provision of multimodal travel information services

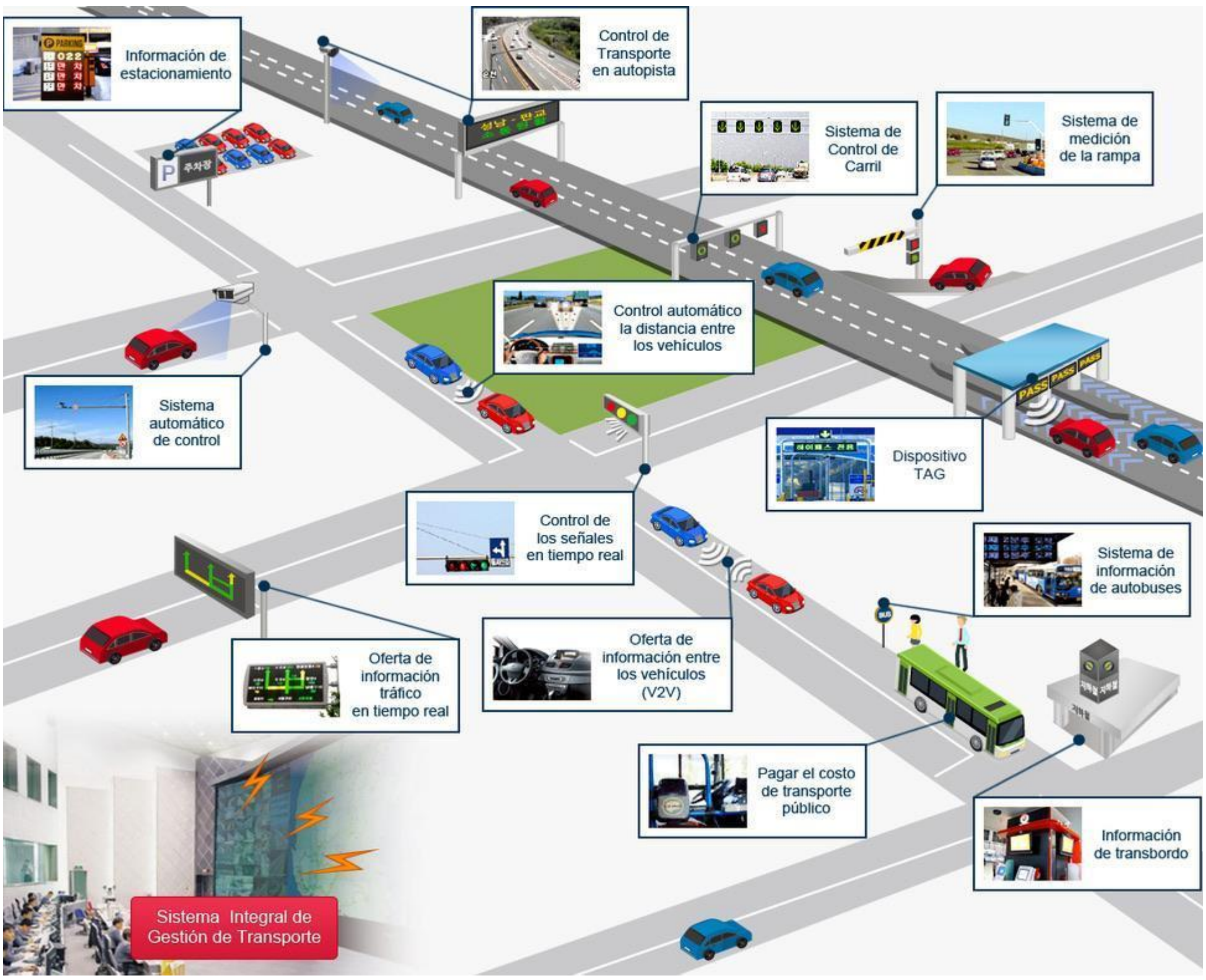

Illustration 4 MOLIT, Ministry of Land, Infrastructure and Transport, Korea

Some applications of ITS in urban mobility:

- Regulation and control of access to certain urban areas.
- Real-time data capture on intensity, speed and incidents on public roads
- Route information
- Tolls and demand control in multimodal mobility. Smart cards
- Optimisation of urban road infrastructure
- Increased safety levels
- Improved traffic management contributing to the reduction of emissions, consumption of renewable resources and waste generation
- Reduced noise pollution levels
- Optimisation of the urban transport network, by Operation Support Systems (OSS), providing managers and users with information to improve the quality of the service.

3.2.2. Geographic information systems

Geographic Information Systems (GIS) are used for the analysis, processing and representation of spatial data as a working tool for georeferenced information. The creation of GIS inventories for urban mobility management makes it possible to have detailed, orderly and efficient information records. Thus, the digitisation of mobility planning in municipalities within the smart-transport concept is a necessary instrument for the establishment of sustainable mobility.

GIS applications:

- Spatial analysis in transport networks as a consultation tool on road network, directions, flows, dimensions
- Calculation of network properties, connectivity, diameter, optimal route selection
- Traffic management and control

3.2.3. Design and planning of cycle paths relating demand circuits to physical characteristics of possible routes

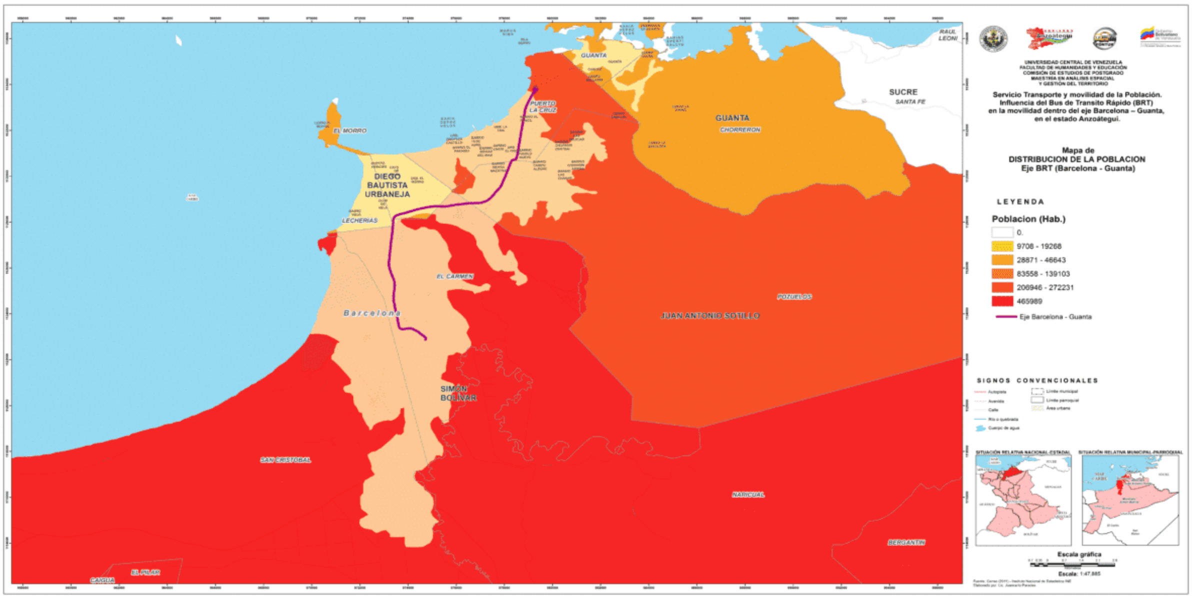

Illustration 5 Analysis of differential accessibility patterns from geoinnova website

3.2.4. Quantitative indicators

For the diagnosis and evaluation of the situation regarding urban mobility, a series of indicators are also used which aim to translate various issues into numerical language to allow comparison over time, as well as other associated factors.

Modal split indicator

$$\frac{number\ of\ journeys\ made\ by\ mode\ of\ transport\ (walking, cyling, private\ vehicle, public\ transport, other)}{total\ number\ of\ trips\ generated\ within\ the\ municipality}\ x\ 100$$

Target: <10-20% of private car trips

Pedestrian road space indicator

$$\frac{linear\ metres\ of\ road\ with\ priority\ for\ pedestrians}{total\ linear\ metres\ of\ roadway}\ x\ 100 \quad (1)$$

(2) $$\frac{pedestrian\ road\ area}{total\ road\ area}\ x\ 100$$

Target >65-75%

Bicycle road space indicator

$$\frac{linear\ metres\ of\ cycle\ lane}{linear\ metres\ of\ urban\ road}\ x\ 100$$

Target >80%

Proximity of cycle lanes < 300 m

Road space indicator for public transport

$$\frac{linear\ metres\ of\ cycle\ lane}{linear\ metres\ of\ urban\ roads\ total}\ x\ 100$$

Target >80%

Proximity to public transport stop < 300m

3.2.5. Citizen participation tools

Citizen participation is structured through surveys and that of social agents through consultations. In both cases, for the correct treatment of the information collected, it is necessary to proceed with statistical processing.

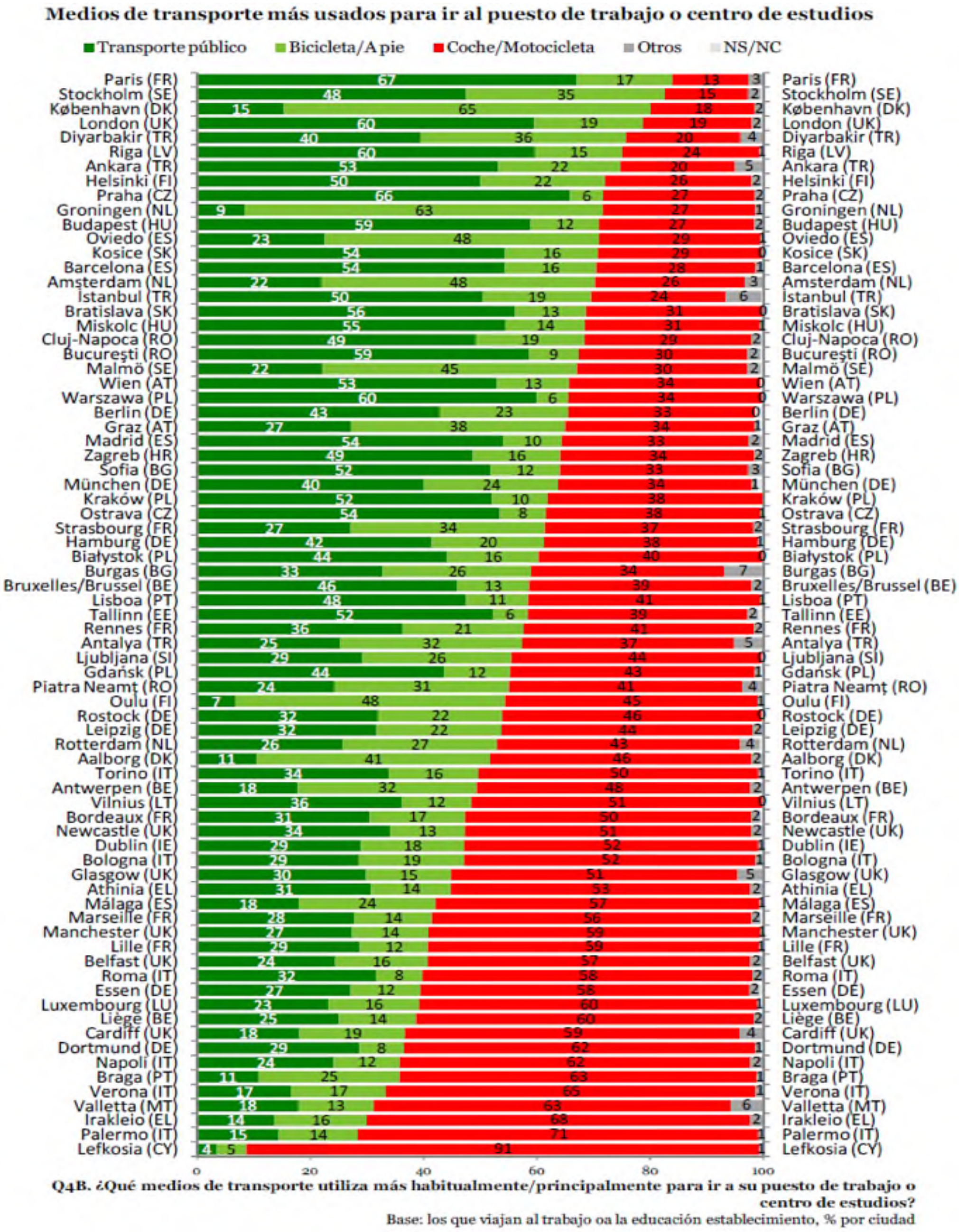

Illustration 6 Mobility Survey of the Community of Madrid (2014) from Madrid Transport Consortium

UNIT 4: CASE STUDY - CYCLE LANES IN CASTELLÓN

This unit will show a case study explaining the management of the bicycle lane in the city of Castellón de la Plana, Spain.

Castelló de la Plana is the capital of the Spanish province of Castellón. It is located in the north of the Valencian Community and geographically to the east of the Iberian Peninsula on a flat expanse of land surrounded by mountain ranges inland and the Mediterranean Sea to the east.

According to the National Institute of Statistics (2019) the city has a population of 171,728 inhabitants and an area of 107.50 km2.

The climate of Castelló is generally cold semi-arid (BSk, Köppen climate classification), very close to the border with the Mediterranean climate (Csa). The average temperature is 17.5ºC, ranging from 10.4ºC in January to 25.0ºC in August. Annual rainfall exceeds 442 mm and there are 300 days of sunshine per year.

Castelló has a vehicle fleet of 495 cars per 1000 inhabitants. The city bus service has a fleet of more than 40 units that provide service on 18 regular lines, diesel and CNG (compressed natural gas). There is also a trolleybus line, TRAM, which links the Grao and the Jaume I University. A single transport card integrates the city's public transport systems.

In order to achieve the double objective of making the bicycle a safe, comfortable and easy-to-use everyday mode of transport, and to increase the share of cycling in the modal split, the municipal authorities of Castelló have a "Master Plan for the use of bicycles in Castelló". This plan includes measures for the planning of cycling infrastructures and bicycle parking facilities, proposes initiatives to promote cycling and the collaboration of the Mobility Forum, which provides information on the real needs of users through their contributions.

The Master Plan is divided into two phases:

- First phase: diagnosis of the current situation of cycling as a mode of urban transport and progress in network planning. Making it available for public participation through the Mobility Forum.
- Second phase: design of the cycling infrastructure network together with the rest of the measures for the promotion of cycling.

Illustration 7 Urban cycle lane from the City Council of Castellón de la Plana

- The total length of the cycling network is (2014):

Type	Length (metres)
Interurban cycle lane	21.918
Urban cycle lane	32.112
Itinerary zone 30	4.604
Itinerary on pavements	4.019
Road itinerary	14.249
Green spaces	1.901
TOTAL	78.804

- Typology of cycle lanes

Cycle lane	Cycle lane running alongside the carriageway, in one or two directions of travel
Protected cycle lane	Cycle lane with side elements that physically separate it from the rest of the carriageway as well as from the pavement.
Cycle pavement	Signposted cycle lane on the pavement
Cycle track	Cycle lane, segregated from traffic, independent of road layout
Cycle path	A road for pedestrians and cyclists, segregated from traffic, running through parks and gardens.
Cycleway	Conventional road shared with motor vehicles with a 30 km/h limit
Convenience street	Shared road with pedestrians and traffic, limited to 20 km/h and with pedestrian priority.

- Implementation criteria

The design must have continuity and homogeneity in its layout, being as direct and continuous as possible. The width should be adequate to be used with the greatest guarantee of safety and comfort. The pavement must have a good adherence, preferably bituminous (red mixtures), concrete or cement.

- Signage

Signage must be an instrument for promoting cycling, it must promote the perception of the existence of a cycle route and its conditions of use, and it must be an indispensable element for regulating urban traffic. The signage used includes vertical and horizontal signs, specific signs at intersections, separation elements and traffic lights.

- Bicycle parking (AparCas)

Having a good network of bicycle parking facilities is fundamental within the overall strategy for the promotion of cycling and also helps to minimise bicycle theft.

The city of Castelló has 83 bicycle parking facilities with 777 U-inverted and wheel type parking spaces. The installation of bicycle parking facilities at source is also encouraged.

The AparCas secure bicycle parking service consists of 16 secure bike racks. The service requires prior user registration via a mobile phone application.

- Bicycle registration

Castelló belongs to the Cities for Bicycles Network where a bicycle registration system has been developed at national level incorporating active mechanisms aimed at limiting bicycle theft on public roads.

- BICICAS

The BICICAS bicycle loan service consists of a network of automated bicycle parking areas where bicycles are available for use by the public in the city. The user must first register for the service through a mobile application, where a system of tariffed subscriptions allows the use of the bicycles.

Through the application, the user receives in real time the locations of the nearest depots, along with the number of available units. They can also access their personal account where they are informed of loans consumed, incidents reported and penalties received.

If you do not have a user card, you can also access the loan service using your mobile phone with the App and an active subscription. A PIN code to be used for the occasion is sent to the mobile phone.

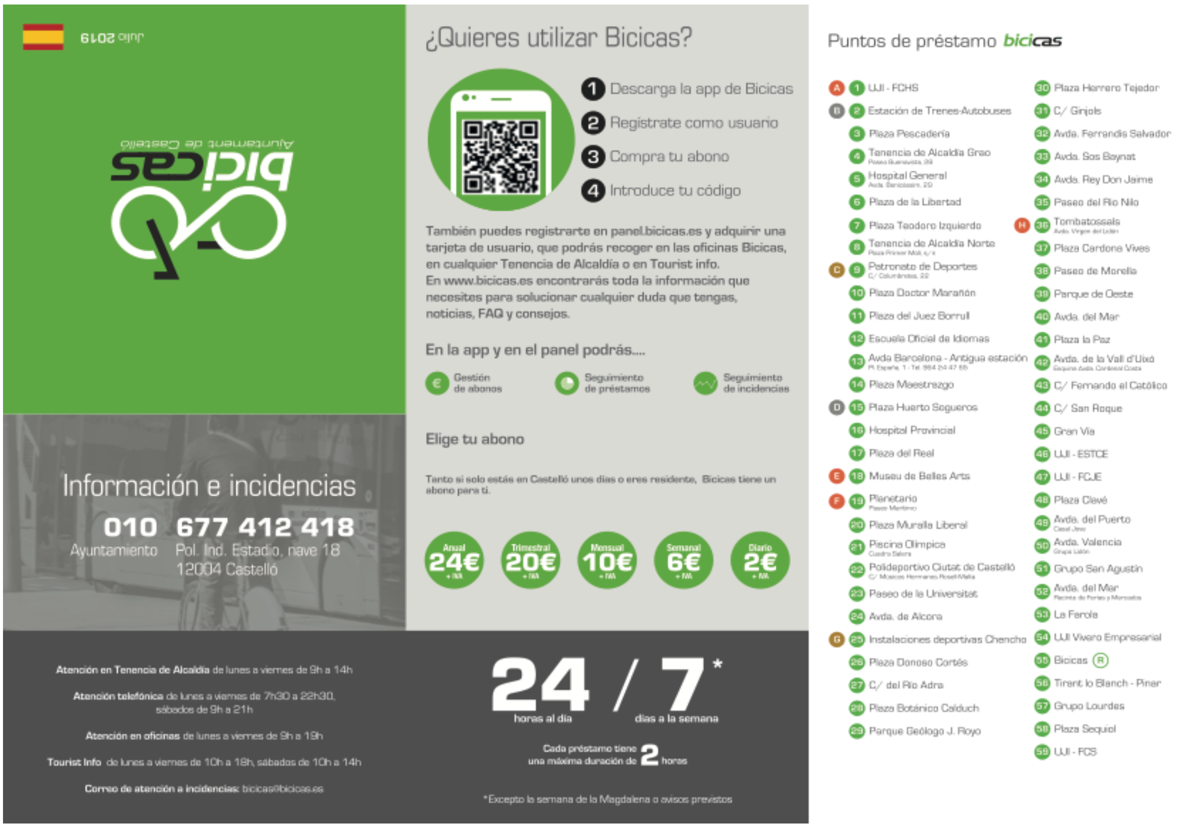

Illustration 8 Bicicas leaflet from www.bicicas.es

- Promotion and education tasks

The Master Plan for Cycling in Castelló aims to create a cycling culture in order to achieve the objective of making cycling an everyday mode of transport in the city.

The aim is to promote cycling as a means of urban transport through a change of attitude towards its use. To this end, the following are implemented:

- Actions of the road safety education group of the local police within the educational programmes in infant, primary and secondary education.
- Practical training in bicycle riding at the children's traffic park.
- Dissemination campaigns on regulations and safety measures for bicycle use.
- Respectful Mobility Project

As part of the road safety awareness campaign, a manual for bicycle drivers is available to all citizens of Castelló, which sets out the rules of the road for this type of vehicle and how to coexist in urban areas in order to guarantee road safety.

Evaluation and monitoring

In order to evaluate and monitor the actions, evaluation indicators are defined according to the objectives set and, in the event that deficiencies or problems affecting these are detected, the proposal and design of viable alternatives.

As an overall assessment indicator, the following is used:

- Number of private bicycle trips per day

As partial indicators:

- Length of cycleways implemented
- Number of signs in place
- Number of bicycle racks in service
- Length of cycle lanes implemented, accident rates and street speeds
- Number of training courses and awareness-raising campaigns

BICICAS Indicators:

- Number of registered users
- Number of daily uses per bicycle
- Number of withdrawals from the system

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