

TeMA

Journal of
Land Use, Mobility and Environment

This special issue collects a selection of peer-review papers presented at the 8th International Conference INPUT 2014 titled "Smart City: planning for energy, transportation and sustainability of urban systems", held on 4-6 June in Naples, Italy. The issue includes recent developments on the theme of relationship between innovation and city management and planning.

Tema is the Journal of Land use, Mobility and Environment and offers papers with a unified approach to planning and mobility. TeMA Journal has also received the Sparc Europe Seal of Open Access Journals released by Scholarly Publishing and Academic Resources Coalition (SPARC Europe) and the Directory of Open Access Journals (DOAJ).

INPUT 2014

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Smart City

planning for energy, transportation
and sustainability of the urban system

SMART CITY

PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

Special Issue, June 2014

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TeMA

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TeMA. Journal of Land Use, Mobility and Environment offers researches, applications and contributions with a unified approach to planning and mobility and publishes original inter-disciplinary papers on the interaction of transport, land use and environment. Domains include engineering, planning, modeling, behavior, economics, geography, regional science, sociology, architecture and design, network science, and complex systems.

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This special issue of TeMA collects the papers presented at the 8th International Conference INPUT 2014 which will take place in Naples from 4th to 6th June. The Conference focuses on one of the central topics within the urban studies debate and combines, in a new perspective, researches concerning the relationship between innovation and management of city changing.



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EIGHTH INTERNATIONAL CONFERENCE INPUT 2014

SMART CITY. PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM

This special issue of TeMA collects the papers presented at the Eighth International Conference INPUT, 2014, titled "Smart City. Planning for energy, transportation and sustainability of the urban system" that takes place in Naples from 4 to 6 of June 2014.

INPUT (Innovation in Urban Planning and Territorial) consists of an informal group/network of academic researchers Italians and foreigners working in several areas related to urban and territorial planning. Starting from the first conference, held in Venice in 1999, INPUT has represented an opportunity to reflect on the use of Information and Communication Technologies (ICTs) as key planning support tools. The theme of the eighth conference focuses on one of the most topical debate of urban studies that combines , in a new perspective, researches concerning the relationship between innovation (technological, methodological, of process etc..) and the management of the changes of the city. The Smart City is also currently the most investigated subject by TeMA that with this number is intended to provide a broad overview of the research activities currently in place in Italy and a number of European countries. Naples, with its tradition of studies in this particular research field, represents the best place to review progress on what is being done and try to identify some structural elements of a planning approach.

Furthermore the conference has represented the ideal space of mind comparison and ideas exchanging about a number of topics like: planning support systems, models to geo-design, qualitative cognitive models and formal ontologies, smart mobility and urban transport, Visualization and spatial perception in urban planning innovative processes for urban regeneration, smart city and smart citizen, the Smart Energy Master project, urban entropy and evaluation in urban planning, etc..

The conference INPUT Naples 2014 were sent 84 papers, through a computerized procedure using the website www.input2014.it . The papers were subjected to a series of monitoring and control operations. The first fundamental phase saw the submission of the papers to reviewers. To enable a blind procedure the papers have been checked in advance, in order to eliminate any reference to the authors. The review was carried out on a form set up by the local scientific committee. The review forms received were sent to the authors who have adapted the papers, in a more or less extensive way, on the base of the received comments. At this point (third stage), the new version of the paper was subjected to control for to standardize the content to the layout required for the publication within TeMA. In parallel, the Local Scientific Committee, along with the Editorial Board of the magazine, has provided to the technical operation on the site TeMA (insertion of data for the indexing and insertion of pdf version of the papers). In the light of the time's shortness and of the high number of contributions the Local Scientific Committee decided to publish the papers by applying some simplifies compared with the normal procedures used by TeMA. Specifically:

- Each paper was equipped with cover, TeMA Editorial Advisory Board, INPUT Scientific Committee, introductory page of INPUT 2014 and summary;
- Summary and sorting of the papers are in alphabetical order, based on the surname of the first author;
- Each paper is indexed with own DOI codex which can be found in the electronic version on TeMA website (www.tema.unina.it). The codex is not present on the pdf version of the papers.

SMART CITY PLANNING FOR ENERGY, TRANSPORTATION AND SUSTAINABILITY OF THE URBAN SYSTEM Special Issue, June 2014

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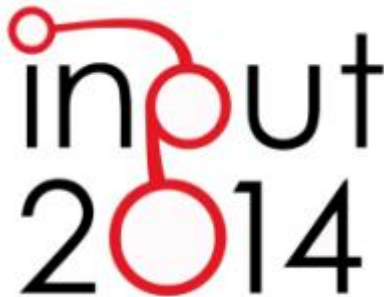
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SPECIAL ISSUE

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ITS SYSTEM TO MANAGE PARKING SUPPLY

CONSIDERATIONS ON APPLICATION TO THE "RING"
IN THE CITY OF BRESCIA

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ABSTRACT

Brescia's downtown is outlined by link roads built up at the Venetian walls, known as "Ring. The "Ring" is characterized by high traffic flows, as well as by the presence of several paid parking lots located on and off street. Furthermore, several facilities are located on these link roads. Nowadays city of Brescia is equipped with an ITS system able to manage off street parking spaces, allowing the share of information about parking availability to potential users, through the use of variable message panels. The parking supply issue and its management are strongly felt by citizens, as well as many other cities communities, whether European or not. This contribution aims to encourage an integration of the existing ITS system for the off street parking management with additional devices, which allow to manage also the on street paid parking supply located on "Ring" roads. The minimization of so-called "shared traffic" component of traffic flows, as well as the increase of road safety, in the context of a medium-sized Italian city are the main objectives of the ITS system integration. ITS asset chosen for the Brescia case study springs from the analysis of some non-European experiences about on street parking management (for example, San Francisco and Boston) and certainly can be considered suitable for the parking supply management of the whole city. It could become the main starting point in Italian cities for the application of performance based parking pricing, widely experienced in many U.S. cities.

KEYWORDS

ITS, smart parking, parking management, sensors, information

1 SMART CITY AND SMART PARKING

The term "Smart city" nowadays is widely used referred to all design and management aspects of city facilities. Activities related to "Smart mobility" aim to meet the needs of the transportation users, in terms of efficiency and environmental sustainability. The use of the Intelligent Transport Systems (ITS)¹ is fully recognized as an integration between the needs of the transportation sector and telecommunications devices. The ITS acronym is recalled in the most recent European and Italian regulation referring to systems defined as advanced applications which aim to provide innovative services relating to different modes of transport and traffic management, without being endowed with intelligence in the proper sense. ITS systems also enable users to be better informed and make the use of transportation networks safer, more coordinated and more intelligent². The main purpose of ITS systems applied in transportation field is to increase safety (in terms of protecting the life of people) and security (in terms of vehicles protection).

In current ITS framework, some systems available on the market are specifically aimed to manage the transport of people. These systems differ primarily on the objective to be pursued and on their influence (direct or indirect) on mobility.

Among these, the ITS systems can be subdivided into the following categories:

- Advanced Traveler Information System (ATIS), designed to directly influence the choice of travel thanks to the real time traffic information;
- Advanced Driver Assistance System (ADAS), designed to influence the running of the vehicles in terms of speed and route;
- Advanced Traffic Management System (ATMS), conceived to indirectly influence the choice of travel thanks, for example, to the management of traffic light cycles;
- Advanced Travel Demand Management System (ATDM)³, engineered to directly affect the times of displacement and the mode of transport;
- Advanced Public Transport System (ATPS), applied to the transport demand/supply, integrating the monitoring of vehicles positioning and the real time information to users.

The current use of Advanced Parking Management Systems (APMS) is included in the ATDM category mentioned above.

As regards Italian regulation, the European Directive 2010/40/UE has been implemented in February 2013⁴, anticipated by "Decree Growth"⁵. It sets the need to ensure the largest possible nationwide diffusion of ITS systems, assuring their efficiency, rationalization and cheapness of usage. Furthermore, it's mentioned the necessity of the availability of free information about road facilities and traffic. In February 2014, the

¹ Bruno Dalla Chiara *et alii* (2013)

² Directive of the European Parliament and of the Council 2010/40/UE of 7 July 2010 on the framework for the deployment of Intelligent Transport System in the field of road transport and for interfaces with other modes of transport.

³ The Transport Demand Management (TDM) discourages the use of the individual motorized transport, through "push" policy (i.e. parking pricing schemes, parking time limits) or "pull" policy (in terms of actions for the improvement of the quality of public means of transport).

⁴ Decree-Law of 1 February 2013 "Diffusione dei sistemi di trasporto intelligente (ITS) in Italia", G.U. n.72 of 26 Marzo 2013.

⁵ Art.8, par.9 in Decree-Law n.179 of 18 October 2012 "Ulteriori misure urgenti per la crescita del Paese", G.U. n.245 of 19 October 2012, ordinary Supplement n.194 (converted with amendments by Law n. 221 of 17 December 2012, G.U. of 18 December 2012 n.294, ordinary Supplement n. 208).

Ministry of Infrastructure and Transport adopted the national "Action plan" for the ITS⁶ systems, stating priorities, timing and implementation tools.

UNI and ISO regulations should be considered as a reference to the technical compliance of ITS devices.

2 ITS SYSTEM FOR PARKING MANAGEMENT

Since 70s in Japan and Europe some systems for the reduction of traffic congestion have been already widely introduced⁷. These kind of systems were used to facilitate the choice of the parking lot mostly in the historical city centre. The spread of ITS system for parking management over the past years has been possible thanks to the recent technological development.

The Federal Highway Administration (FHWA) has given some operative indications regarding the installation of ITS systems. The first one highlights the need to integrate the APMS (Advanced Parking Management Systems) in a more complex ITS architecture built up at regional level, in order to make data collection and information communication more effective. The second recommendation reminds to verify the presence of communication supports and power supply during the design phase, even if the hardware and software devices are often characterized by limited size, energy independence and wireless data communication. As a matter of fact, the lack of continuity of functioning decreases the credibility of the system and the acceptance by users, who could consider communicated information not reliable. The FHWA therefore recommends to clearly establish the responsibilities of the involved authorities in relation to the maintenance and management of installed systems.

2.1 ARCHITECTURE AND COMPONENTS OF THE SYSTEM

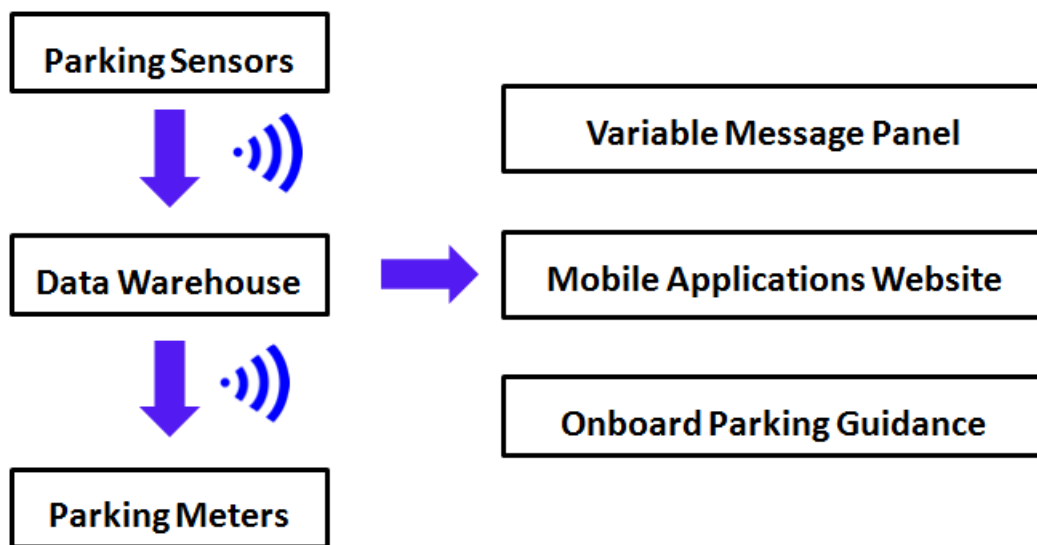


Fig. 1 System architecture for parking supply management

The Advanced Parking Management Systems (APMS) are usually composed by the following components:

- Sensors: they are used to collect the number of occupied parking spaces (on and off street) and to control cars presence. Focusing on data collection process, nowadays the sensors available on market can be differentiated by their technology: one is based on optical technology and the other on

⁶ Ministerial Decree n.44 of 12 February 2014 "per l'adozione del Piano di azione nazionale sui Sistemi Intelligenti di Trasporto (ITS)", implementino Directive 2010/40/UE, cit.

⁷ In reference to a study of Federal Highway Administration (FHWA), 2007

magnetic/ultrasonic one. The first type is composed by a camera with CCTV images and a software, able to distinguish the presence of a car in the parking space. This kind of technology is more suitable for parking structures, because light conditions and weather are more stable. As a matter of fact, their use in parking structure makes the image processing by software more reliable. In relation to the architecture of cameras system, it's able to count the number of vehicles entering and exiting the parking. If cameras are installed in correspondence of each stall it is able to provide for each parking spot the localized information to help users in their parking choice.

- The second type of sensor is based on non-optical technology. As many sensor are available on the market, it is necessary to choose the ones more suitable to the system applied to the considered parking lots (i.e., it is advisable to install different sensors for parking on the street than off street). The choice of the type of sensor is also affected by size, reliability, climate change adaptability and price. Those sensors can be divided into two categories: intrusive, if need to be installed directly under road surface; non-intrusive, if need to be only fixed on a stand.
- Magnetic sensors are able to detect a parked vehicle thanks to the variation of geomagnetic field. The collected data are sent to centralized processing system through wireless connection. These sensors are feed by a long-life battery (generally it lasts more than 5 years) and they are waterproof. Therefore, they can be used in several applicative solution (both on and off street parking lots).
- Software: data recorded by sensors need to be processed by a centralized system (hardware and software). The most commonly used softwares are used to: check vehicles entering and exiting the parking, identify available parking spaces, indicate the preferential route to get to parking lots, determinate the parking rate compared to its required performance. Nowadays these softwares are able to work in real time or at set time intervals. An appropriate database is required in order to ensure reliability of the outputs obtained by the software processing. As a matter of fact, data redundancy has to be guaranteed to avoid possible system temporary failing. Finally, the hardware needs to be provided with UPS, pc, cables, antennas, power pack installed in a centre manned for controlling the correct operation.
- Users information: the information systems can condition the choice of trip both before the departure and during the journey. As a matter of fact, in the former case it's possible to distribute the transportation demand in space and time of the day. It is possible thanks to information spread about the availability of free stalls, indicating their geographical location within the municipal area. While in the second case the information disclosed during the journey may announce for example the conditions of circulation, regulate traffic (indicating alternative routes and detours recommended) and warning of imminent danger (to allow users of reducing their speed and to adapt their behavior). Among information systems available on the market, Variable Message Panel (VMP), specialized websites and smartphone applications are the most used to manage parking availability. Furthermore, the use of on-vehicle integrated navigation system has been recently applied.
- The VMP is widespread in European and non-European countries, usually installed on the main and most congested roads both in urban and suburban areas. The type of device needs to be selected in relation to the kind of information composing messages with text and pictograms. In the specific case of parking information management, panels can be usually divided into "directional" and "proximity" respect to their function within the controlled area: the first ones (in Italy often characterized by white background) give information about direction to be followed to reach parking areas and the number of available parking lots; the second ones (often with blue background) are installed near parking area to inform if parking spaces and access are available.

- The choice of user route can also be conditioned by the development of specific websites and smartphone applications. The two interfaces need a similar architecture, to receive information from the same parking database and to increase their usability and effectiveness.
- Finally, recent technology development has allowed experiments of in-vehicle parking guidance system to help user to find the available parking lot. This device can indirectly affect and manage traffic flows: in-vehicle software receive processed data about traffic and parking availability to recommend the preferred (as the shortest and less busy) route to reach the chosen parking space.
- Payment methods: the characteristics of the chosen device determine the possibility to collect spaces payment information and to update parking fees. Among systems available on the market, it is advisable to integrate smart park meters, smartphone applications, specific websites and automatic plate recognition system inside ITS systems.
- Park meters have been the first kind of device used to pay parking (installed since 30s). Over decades, a technology evolution has undergone to make users able to pay with credit/debit cards and parking subscription card. The smart parking meter needs to be equipped with wireless continuous connection to the centralized processing system of parking data (wireless connection is recommended to reduce construction costs for facility).
- Furthermore, smartphone applications and websites are usually able to accept parking payment, but they are also characterized by high development and operational costs, as well as need to establish specific contracts with banks and telephone companies to allow money flow. From an operating point of view, the ease of information updating of both interfaces is strictly linked to the use of only one data source for parking fees, as well as for parking occupation rate. If the system collects and processes data in real time, applications and websites can be integrated with a new functionality, which allows users to book parking lot in advance.
- Finally, the use of automatic recognition plate system has recently begun to spread mainly for payments of off street parking. The system is composed by cameras installed at the entrance and exit of the parking area (or structure), which are able to automatically recognize each vehicle plate and to charge the cost of the car park on the users bank accounts, as well as on their credit cards.

2.2 CASE STUDIES AND BEST PRACTICES

San Francisco and Boston have been considered as best practices in parking supply management with ITS application.

San Francisco

- In 2011, the pilot program "SFpark" has been implemented in order to dynamically manage both on and off street parking supply of the city. The main characteristic of the project is the calibration of parking fees based on parking occupancy rate. The ITS system is shown schematically in the figure below.

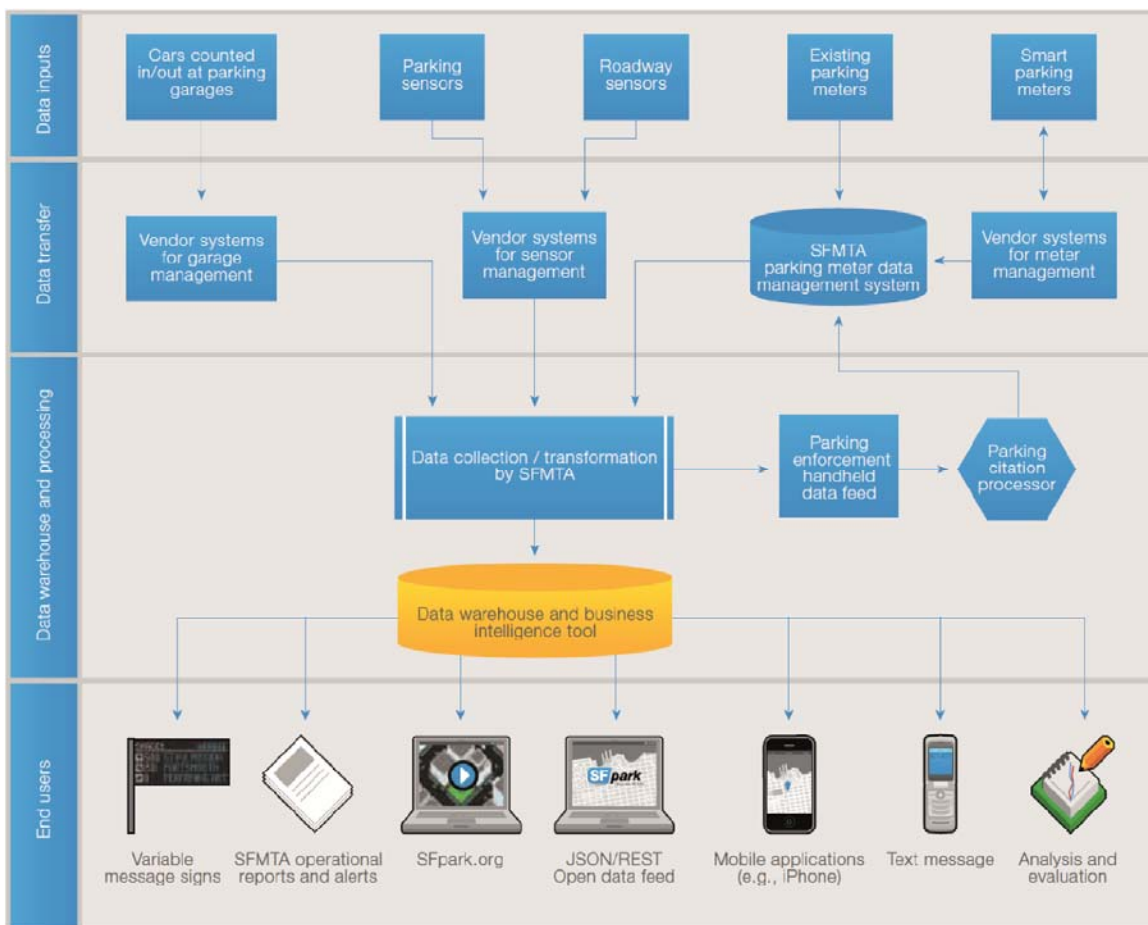


Fig. 2 Architecture of ITS system installed during "SFpark" pilot program in San Francisco

- After outlining the pilot area of the project within the city (namely neighborhoods Marina, Fisherman's Wharf, Fillmore, Downtown, Civic Center, South Embarcadero, Mission Port of San Francisco), magnetic sensors have been installed to monitor on street parking occupancy rate (one for each parking lot located on street) and also at the entrance and exit of parking areas and structures. Fees payment within the pilot area has been managed by new smart park meters, replacing old ones to accept payment with credit/debit card and to manage longer parking time limits. They are also able to collect payment transactions to update centralized data warehouse. These data are sent by wireless connection. During "SFpark" program implementation, several "single lot" park meters (more than 5000 devices) and "multi lot"⁸ ones (covering more than 400 parking space) have been installed, characterized by an illuminated display to provide information about fees and time limits.
- The SFpark also included the development of a dedicated website to spread out real time information about the localization of available parking spaces. Furthermore, on the website, documents and reports about results, fees calibration and collected data are periodically published. Furthermore, two smartphone applications were developed replicating website information, as well as adding several static data about suggested itineraries to reach chosen parking spaces. They have been designed after traffic surveys. These information were provided in order to reduce the number of vehicles searching of available car parking space on the most congested roads.

⁸ While the "single lot" meter is installed near one specific parking space and allows to pay only for its occupation, the "multi lot" one allows to pay for a block of spaces, usually for a maximum number of 8.

Boston

- In April 2013 the City Council of Boston approved a pilot program to manage parking supply and traffic flow within a newly built neighborhood so-called "Innovative District"⁹. The project included the installation of magnetic sensor for on street parking spaces and smart park meters. It was designed as a fundamental part of recent city level plan called "City of Boston's complete street strategy". The project aims to discourage the use of private motorized vehicle mostly for commuters' trips.
- The pilot project consisted in the installation of 330 magnetic sensors for on street parking lot along the main and most congested roads of the pilot area, 4 additional VMP to give information about the waiting time to reach parking spaces, as well as "multi lot" smart park meters replacing the old ones. Furthermore, a specific application was developed to widespread real time information about parking availability. The new ITS system has been integrated with the existing one, which is equipped with traffic control cameras and an operation centre (so-called Traffic Management Center). These new devices were chosen because their specifications could allow the city to apply a variable parking pricing project, to date under evaluation.

3 HYPOTHESIS OF ITS APPLICATION IN BRESCIA FOR PARKING MANAGEMENT

3.1 STATE OF THE ART

The city of Brescia is characterized by a nearly round shape of the historic center, surrounded by very congested streets, known as "Ring". These roads are one-way roadways with multiple lanes. The main paid street parking spaces serve the historical center, as well as the main attractors of traffic.

The so-called "Ring" has always been characterized by high values of traffic flows during peak hours of working days. This trend is shown by the traffic data collection attached to the "Brescia PGT" (the city urban plan). As well known, the traffic component due to the search of the on street available spaces need to be considered as an element of substantial importance while carrying out the traffic analysis.

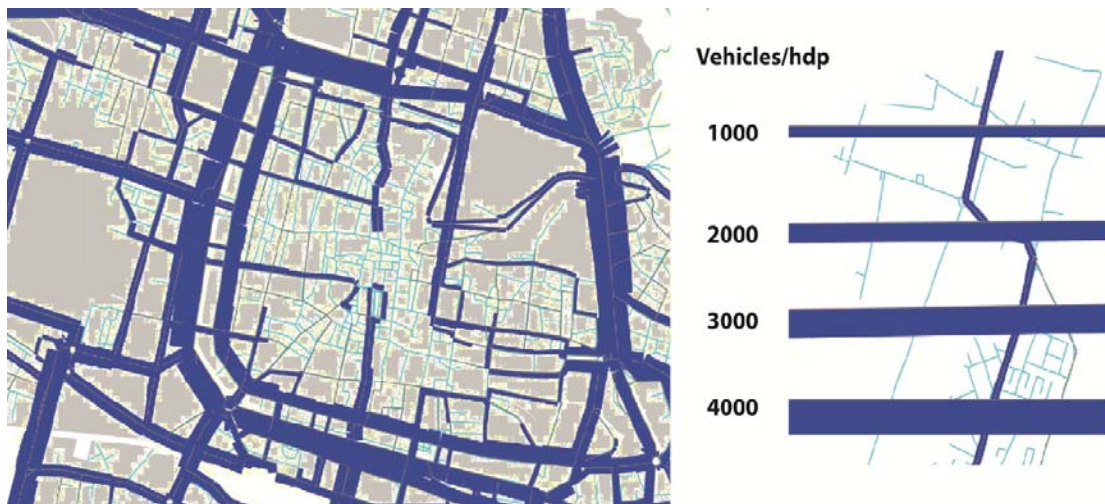


Fig. 3 Traffic simulation of the state of the art in the core of the city of Brescia

⁹ This district has been recently designed and built up (but not yet completed), in which several innovative projects from transportation and urban planning point of view have been implemented.

The main target is to focus a smart manage system and information channel for users on the existing parking system in the municipality of Brescia. The idea is to enlarge and complete the existing ITS system nowadays only dedicated to the off street parking.

As regards parking supply, the pilot area includes 13 parking structures, with a total of 6757 parking lots and in addition 1792 on street paid parking spaces. In 2010 a manual site inspection was carried out to investigate the occupancy rate parking spaces located on streets. The results are shown in the following map.

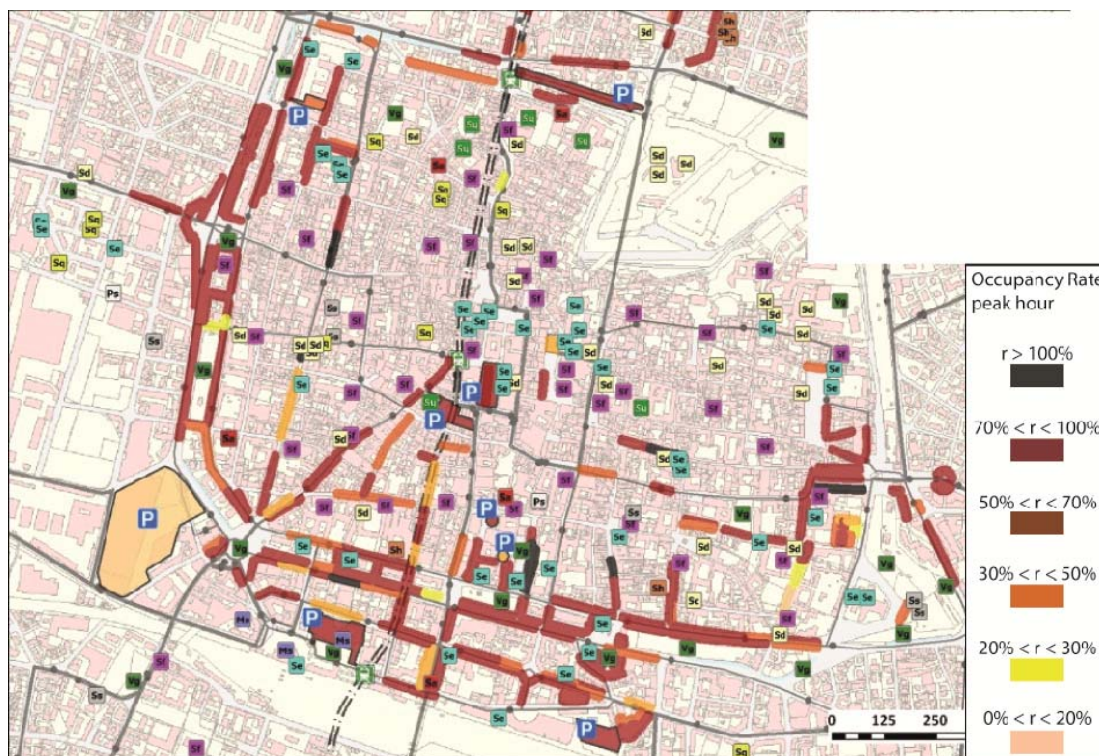


Fig. 4 Scheme of the occupancy rate of on street parking in the pilot area during the working day peak hours updated to 2010

Furthermore, the parking occupancy rate of the off street parking lots was update to 2013 (where available), as following.

| Off street parking | Number of parking spaces | Occupancy rate - peak hour – working day [%] |
|--------------------|--------------------------|--|
| Arnaldo | 270 | 7,29 |
| Autosilo | 350 | 42,54 |
| Benedetto Croce | 72 | 38,89 |
| San Domenico | 72 | 61,11 |
| Fossa Bagni | 560 | 24,70 |
| Freccia Rossa | 2500 | 23,11 |
| Piazza Mercato | 190 | 78,61 |
| Palagiustizia | 570 | 83,57 |
| Piazza Vittoria | 450 | 88,72 |
| Randaccio | 180 | 52,83 |
| Stazione | 1000 | 62,78 |

Tab.1 Occupancy rate of parking structures in the pilot area during working day peak hours update to 2013 (Source: Brescia Mobilità S.p.a.)

The results reported above shown that the occupancy rate of on street paid parking spaces is on average higher and often near 100%. On the contrary, the occupancy rate of off street parking is very low, with the exception of three structures, namely Piazza Mercato, Piazza Vittoria and Palagiustizia: the first and the second are barycentric to the downtown, the third is near the law court of the city. The results follow those obtained in other countries.

The municipality since 1980 had decided to use VMP to give information to users about the road traffic. Thanks to the "Impiego VMP"¹⁰ research program, it was possible to define the state of the art all over the municipal territory, localizing existing VMP network also including panels dedicated to off street parking information.

This research identified 3 main types of VMP in Brescia:

- "blue panel" (28 all over the city), located near parking structures indicating the accessibility to the car parking;
- "white panel" (39 all over the city), directional and informative ones concerning the number of spaces available in each off street parking;
- "standard panel" (11 all over the city), able to give several information (panel text and symbology) to communicate any kind of message, including available parking supply.

Brescia Mobilità S.p.a. is in charge to manage parking supply in Brescia. To reach this goal it has developed a website with information concerning available parking spaces and city mobility¹¹. Furthermore, during the CIVITAS plus MODERN European project, two smartphone applications were developed to give real time information about off street parking available spaces.

The evident aim of this approach is to investigate and suggest a possible integration of the existing ITS system with new application, in order to manage both on street parking spots and real time information about their availability. The new ITS system aims to emphasize benefits given by a proper and complete management of parking supply and demand, in order to make urban areas of the city more livable for citizens. Thus, the high level objectives of this proposal consist in a reduction of traffic congestion, a reduction of air pollution and an increase of road safety.

3.2 PROPOSAL OF ITS SYSTEM TO MANAGE PARKING SUPPLY IN PILOT AREA IN BRESCIA

The project suggests to integrate existing ITS system for off street parking spaces with additional devices: magnetic sensors, VMP and smart park meters to manage on street paid parking.

Above all, the streets of the pilot area have been divided into homogeneous segments in regard to the placement and to the type of paid parking lots, in order to give more comprehensible information. Furthermore, the integrative ITS system includes new devices, as anticipated above:

- 1792 magnetic sensors for on street parking lots in the pilot area (one for each space) to collect and wireless communicate occupancy rate and localization of free parking spots. These devices have been suggested because they can be installed just below the road surface;
- new smart park meters, characterized by wireless connection to the operative centre in order to transmit all the parking transaction data; if possible it is advisable to modify the existing park meters hardware to allow continuous connection to the operative centre;
- new VMP (better "white" ones) in the pilot area to communicate parking availability to users.

¹⁰ This research has involved University of Brescia, University of Cagliari and Brescia Mobilità S.p.a.

¹¹ More information to date are available on the web site, for example the localization and availability of bike sharing, the bus and metrobus stops localization, their timetables, etc.

The new data can be processed thanks to existing system, which manages the off street parking supply. The system architecture here suggested, once fully operational and suitably integrated to the existing one, would allow to receive reliable information updated in real time about the available parking spaces within the pilot area.

Furthermore, the outputs of parking data processing need to be spread through already existing and recently renewed smartphone applications and website.

The proposal of this study includes also the integration of new functionality to indicate suggested itineraries to reach the chosen parking lot. It's considered suitable for the city of Brescia, as the data flows have already been surveyed.

The monitoring phase of the effectiveness of the new ITS system is advisable to be carried out processing collected data remotely transmitted by traffic inductive loops already installed in the pilot area. This activity would allow to detect traffic variations after the calibration of ITS parking management system. This one would also allow to obtain environmental benefits, which can be evaluated through specific indicators of air pollution, even if the results are punctual. Those data can be collected through the pollutant stations already located near and within the pilot area. The significance of the parameters variations will be more evident if the ITS architecture would be enlarged to the management of whole parking supply of the city of Brescia.



Fig. 5 Traffic inductive loops and pollutant station already installed near and within the pilot area (localization updated to 2013)

Finally, the use of simple online survey would help the evaluation of the effectiveness of the new ITS system (i.e. asking users how often they follow the panel indication to choose the parking lot) and to collect actual users suggestion to improve both the website and smartphone applications.

3.4 EXPECTED RESULTS

After the evaluation of new and more complete ITS architecture here described, the city would be able to take into account the applicability of performance based parking pricing. As mentioned for "SFpark" pilot project, this is an innovative approach of parking management based on the definition of the maximum and minimum value of occupancy rate of parking spaces and on the possibility to calibrate parking fees respect

to the actual occupancy rate itself. As a matter of fact, characteristics of the devices suggested allow to collect real time data information both on and off street parking and after data processing to inform and drive users to the preferential car park space.

4 CONCLUSIONS

The availability and occupancy rate of parking spaces have been considered as a problem since the size of the vehicle fleet has become such that the existing parking supply cannot always meet actual demand. Over the years, the increase of existing supply has been the only response. However, in the last decades several cities all over the world have set the goal of reducing traffic and increasing road safety, especially in urban areas. Therefore, the tendency is to act on the existing parking supply not enlarging it, but optimizing its management. Several experimentations and good practices for parking management (San Francisco and Boston are two of these) highlighted that ITS systems could allow to:

- indirectly manage the "shared traffic" component caused by who is looking for parking, also indicating the position of available spaces and less congested route to reach them;
- promote the use of specific parking spaces, especially those off street;
- monitor the occupancy rate of on street and off street parking spaces, to calibrate fees and optimize the use of parking supply;
- control payments, to reinvest collected amount both in parking management and in favor of citizens.

The good practices analyzed in this paper have also demonstrated that ITS systems for parking management need to be integrated with a larger-scale one for traffic management.

In this contribution Brescia, a middle-sized city, was considered as case study. The municipality is characterized by high motorization rate (more than national rate, equal to 621 passenger cars per 1000 inhabitants¹²) and high traffic flows, especially along link roads around the city center. The "Ring" has also got a large parking supply, located both on street (with occupancy rate often near 100%) and off street (with very low occupancy rate). The proposed ITS system, integrated with the existing one for parking management, could be considered a valuable tool for monitoring actual occupancy rate, calibrating parking fees and discouraging the use of on street parking.

REFERENCES

- Bayless S.H., Neelakantan R. (2012), Smart parking and the connected consumer – Opportunities for facility operators and municipalities, ITS American Research. <http://www.itsa.org>
- Boston Transport Department (2013), Boston Complete Streets Guidelines, Boston: Blurb
- City of Boston (2014), Boston taking a new approach to traffic and parking challenges. <http://www.cityofboston.gov/news>
- Dalla Chiara B. (2010), Telematica per i trasporti, Forlì: Egaf
- Dalla Chiara B. (eds.) (2013), ITS nei trasporti stradali – Tecnologie, metodi e applicazioni, Forlì: Egaf
- Federal Highway Administration (2007), Advanced parking management systems: a cross-cutting study. <http://www.its.dot.gov>

¹² The motorization rate is referred to year 2012, calculated as ratio between the number of passenger cars (data source: Automobile Club Italia - ACI) and inhabitants (source: National Institute of Statistics - ISTAT).

Giuffrè T., Siniscalchi S.M., Tesoriere G. (2012), A novel architecture of parking management for smart cities, SIIV – V International Conference "Sustainability of Road Infrastructures", Procedia – Social and Behavioral Science, 53: 16-28

Kianpisheh A., Mustafa N. Limtrairut P., Keikhosrokiani P. (2012), Smart parking (SPS) Architecture Using Ultrasonic Detector, International Journal of Software Engineering And Its Application, 6, 3: 51-58

Maffiotti M. (2011), Servizi pubblici, offerta e domanda di sosta: un contributo al piano territoriale degli orari, Thesis discussed at University of Brescia

Maternini G. (eds.) (2014), Trasporti e città – Mobilità e pianificazione urbana, Forlì: Egaf

San Francisco Municipal Transportation Agency (2011), SFpark: putting theory into practice – post-lunch implementation summary and lessons learned. <http://sfpark.org>

Shoup D. (2011), the high cost of free parking, Chicago: Planners Press

US Department of Transportation – Research and Innovative Systems Joint Program Office (2010) ITS technology adoption and observed market trends from ITS deployment tracking – Final report. <http://www.its.dot.gov>.

IMAGES SOURCES

Figs 1,5: self elaborated

Fig. 2: San Francisco Municipal Transportation Agency (2011)

Fig. 3: Attachment – Traffic flows – State of the art - P.G.T. Urban plan of Brescia

Fig.4: Maffiotti M. (2011).

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