

**TRANSPORT  
MANAGEMENT  
AND LAND-USE EFFECTS  
IN PRESENCE  
OF UNUSUAL DEMAND**

**Selected papers**

**edited by  
Lorenzo Mussone  
Umberto Crisalli**

**FrancoAngeli**

**Società italiana  
dei docenti di trasporti**

**Collana Trasporti**



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### **Reviewing process**

Papers were selected over a two-stage blind peer review process according to International journal standards.

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SIDT 2009 International Conference  
**The effects of important events on  
land-use and transport: towards Milan  
EXPO 2015 and Naples FORUM 2013**

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## *Preface*

*by Agostino Nuzzolo* \*

In 2009, the Italian Society of Transportation Scholars<sup>1</sup> (SIDT) organized its annual international conference. The theme of the conference was “The effects of important events on land-use and transport” and it was stimulated also by two forthcoming related events: the “Forum delle Culture”, Naples, 2013 and notably the “Expo”, Milan, 2015.

Milan was chosen as the venue of the conference in order to debate problems and opportunities related to relevant events, also taking into account the associated new facilities and services that will improve the city’s transport system.

The conference extended over two days.

On the first day the conference focussed on institutional and technical issues related to strategies for planning big events. After listening to the opening speeches of people from different cultural backgrounds and with different points of view, SIDT encouraged discussion with managers of public administrative offices, institution delegates, local authorities and academics. On the second day SIDT hosted a scientific conference that dealt with cases in which transport demand shows values and/or a structure different from normal demand over short, medium, and long time periods. These contributions focussed on analyzing, at all levels, situations arising from a higher than usual demand as regards values and/or with a different time scale.

\* SIDT President, “Tor Vergata” University of Rome.

<sup>1</sup> SIDT gathers all the Italian University Professors and Researchers who study and teach topics of transportation systems.

Following the 2009 conference, a first book came out in 2010 that included the institutional and technical speeches of the first day. This book, on the other hand, contains a selection of the papers presented during the scientific seminar of the second day, regarding mathematical models, and techniques for transport management and the effect of land-use provisions in the presence of unusual demand, as well as some case studies. This is the first book of SIDT proceedings produced in English in order to introduce SIDT activities to the international community. Hence, papers were selected over a two-stage blind peer review of papers submitted after the conference, according to International journal standards.

I wish to thank the editors, the scientific committee, the reviewers and all those involved for their valuable contribution and for the time they devoted to this event.

Selected reviewed papers are a part of the research activities carried out by SIDT members, working in Italian universities to contribute to the community debate on transport systems and related topics, such as land-use, economics, environment and energy in order to support worldwide efforts for a sustainable development.

## *Introduction*

*by Lorenzo Mussone\* and Umberto Crisalli\*\**

This book represents one of the results of the SIDT 2009 international conference. It follows the one that includes the Institutional and Technical Speeches.

As previously mentioned, it is the first book of SIDT proceedings produced in English and papers were selected over a two-stage blind peer review of those papers submitted after the conference, according to international journal standards for which most of papers had had three reviewers.

Paper contents regard mathematical models, techniques for transport management, network planning, railway systems, freight transport and the effect of land-use previsions in the presence of unusual demand, as well as some case studies. Papers are listed according to the presentation order at the scientific seminar and a brief summary for each of them is reported here.

The first paper “*Evaluation and deployment of Inverse Parking Pricing Policy in traffic management for planned special events*” by Vittorio Astarita, Federica Crocco and Giuseppe Guido deals with traffic management in parking systems during special events. A new policy (Inverse Parking Pricing) is proposed and its efficacy has been verified by simulation of a case study scenario based on data collected in an experimental survey.

The paper “*Coping with great events and transportation management: the Rimini case study*” by Antonio Musso and Maria Vittoria Corazza

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presents the new local Urban Mobility Plan of Rimini, according to strategies and interventions to manage both typical seasonal traffic flows, due to everyday activities, and peak phenomena.

The need for emergency management and the ability to perform essential work during an emergency (or disaster) is the subject of the paper *“A model for emergency planning and traffic management during a major public event within an urban road network”* by Salvatore Caprì, Matteo Ignaccolo and Giuseppe Inturri. The authors propose a methodology to be applied to mass-gathering events capable of supporting traffic and emergency planners to assess the entity and the location of the needed resources to face emergencies.

The paper *“Personal Rapid Transit: a self-financing solution for tourist transport at the city of Rimini”* by Antonio Danesi, Marino Lupi, Federico Rupi and Joerg Schweizer develops a preliminary feasibility-analysis for the implementation of a Personal Rapid Transit system in the city of Rimini. Micro-simulations have been applied to address capacity issues in the presence of fluctuating demand and economic sustainability aspects are also discussed.

*“A Petri Net Model for the Assessment of Critical Transportation Infrastructures”* by Angela Di Febbraro and Nicola Sacco aims at defining a methodology for understanding the costs of the “whole damage” deriving from the “chain-effect” caused by a critical infrastructure problem. A Petri Net (PN) modeling approach for distributed networks is proposed to deal with the problem.

Road network planning in unsteady conditions is the subject of *“Network reliability methodology for unusual events”* by Ernesto Cipriani, Gaetano Fusco and Marialisa Nigro who investigate the network robustness features in order to maintain suitable levels of functionality also during unusual events.

*“Assessing traffic impacts related to a new retailer truck access to the Fortezza da Basso Exhibition Centre of Florence”* by Antonio Pratelli, Massimiliano Petri and Lorenzo Tabani describes a simulation study developed in order to state and forecast the impacts made by the new access location on the local traffic network surrounding the Fortezza da Basso in Florence (Italy).

The focus of the paper *“Land-use and economic impacts of High Speed Rail systems: quantitative evidence from the Channel Tunnel Rail Link”* by

Francesca Pagliara, Valerio Brancaccio and John Preston is on the evaluation of the socioeconomic impacts of the Channel Tunnel Rail Link, the High Speed Rail link between London, Paris and Brussels. Precisely the analysis concerns the effects of High Speed Rail accessibility on property prices and residential locations.

An activities location choice model is the subject of “*Modeling urban activities spatial distribution and dwellings price interactions*” by Agostino Nuzzolo and Pierluigi Coppola focused on the metropolitan area of Naples (Southern Italy). In the framework of the Random Utility Theory principles, the proposed model uses endogenous prices in order to simulate the behavior of different agents of the urban system and to estimate the spatial distribution of socioeconomic activities within the study area as well as the impact of differentiated changing accessibility on the price of housing.

The paper “*Demographic, economic and transportation data analysis for exploring land-use and transport relationship*” by Laura Eboli and Gabriella Mazzulla explores the relationship between the regional characteristics of a medium-sized urban area through a GIS approach. Statistical techniques were applied in order to measure the relationship between the variables and to identify unobserved or “latent” variables affecting land-use and transport interactions.

A new formulation of the multi-class user equilibrium with deterministic route choice is proposed in the paper “*Balanced solution of multiclass deterministic assignment through the LUCE algorithm*” by Guido Gentile, which introduces multi-class congestion to reproduce the interaction between different vehicles and proposes a mathematical “trick” for ensuring uniqueness of class/destination link flows in deterministic models.

City logistics and implementable city logistic measures is the subject of the paper “*A classification of urban freight transport measures in relation to planning horizons*” by Francesco Russo and Antonio Comi who propose a classification of possible measures according to some criteria and, in particular, to planning horizons together with involved actors and sustainable goals.

The paper “*Clustering methods for the automatic design of traffic zones*” by Guido Gentile and Daniele Tiddi proposes a clustering algorithm for the automatic design of traffic zones. The method is applied to a real

case with the aim of analyzing the results with respect to different objectives.

The paper “*Ex-post assessment of city logistics measures: the case of Rome*” by Antonio Comi, Paolo Delle Site, Francesco Filippi and Agostino Nuzzolo presents a synthesis of the results of the survey carried out in the inner area of Rome in 2008 investigating urban freight transport and describing the current patterns of freight mobility.

The paper “*Freight demand estimation on a national level considering uncertain data: a fuzzy optimization based approach*” by Leonardo Caggiani, Giuseppe Longo, Michele Ottomanelli and Domenico Sassanelli proposes a method, yielding to a fuzzy fixed point problem to improve the estimates of trade rates and production levels for each economic sector on a national level. It starts from uncertain present or past information about the same trade rates and productions, and final demand.

The “*Fuzzy systems approach versus possibility theory approach for representing customers' preferences on freight transportation services*” by Riccardo Rossi, Massimiliano Gastaldi and Gregorio Gecchele investigates, using a “Stated Preferences” (SP) type survey, the attitude towards changing transportation service issues in terms of frequency and quantity of transported freights by means of two different approaches: fuzzy sets and possibility theory and fuzzy system methodologies.

The book ends with the paper “*Neuro-fuzzy Decision Support System for relocation process in car sharing systems*” by Mauro Dell’Orco, Leonardo Caggiani and Domenico Sassanelli who consider the problem of the relocation process of shared cars and present a more flexible decision support system for relocation based on neural networks and fuzzy logic.

The editors wish to thank the scientific committee, the many skilled reviewers and all those involved for their valuable contribution and for the time they devoted to this event. Most of the members of SIDT were involved in one way or another, so they are too numerous to mention. A special thanks, however, is due to Prof. Giulio Erberto Cantarella and Prof. Agostino Nuzzolo who believed in and supported this work from beginning to end.

# *Evaluation and deployment of Inverse Parking Pricing Policy in traffic management for planned special events*

*by Vittorio Astarita<sup>\*</sup>, Federica Crocco<sup>\*</sup> and Giuseppe Guido<sup>\*</sup>*

## **1. Introduction**

The purpose of this work is to investigate traffic management issues around specific buildings, hosting planned special events, like shows or sport events. The work is focused on evaluating the effects of some traveler information systems and ITS services on the distribution of arrivals and departures to/from the parking lots near to sports and show centers (outdoor and indoor stadiums, big theatres, etc.).

ITS can play an important part to solve this kind of management and traffic control problems. ITS, in fact, allow to transform the transportation system into an “integrated system”, in which traffic flows are distributed to obtain more efficiency and more safety. Systems and features already realized and applied, both in urban and in suburban scenarios, allow to evaluate some of the benefits reached in ITS applications.

In this work, control and management strategies at parking areas are proposed. The proposed integrated system solutions are investigated and simulated by the use of simulation models.

In order to evaluate different scenarios and compare normal conditions with ITS implementations, traffic simulation has been developed. The simulated scenario assumes that traffic demand from/to parking areas can be regulated and assigned to the road network according to the use of automatic ticketing systems and informative SMS directions.

The main result of this paper is to present and evaluate some new effective proposals for some specific ITS applications to parking systems and traffic regulation for planned special events. The results of the evaluation on the overall congestion levels of the road network, as a

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consequence of the proposed system implementation, show that the system can greatly help in reducing traffic impacts.

## **2. Overview**

Planned special events can have a serious impact on the transportation system by generating a concentrated in time and space travel demand that can saturate a reduced capacity network.

Five main categories of planned special events can be identified (Latoski et al., 2003):

- discrete/recurring event at a permanent venue;
- continuous event;
- street use event;
- regional/multi-venue event;
- rural event.

A discrete/recurring event occurs on a recurring basis, and it has a definite starting time and expected ending time. For this reason it is easier to predict arrival and departure rates than in other kind of planned special events. These events are critical cause they generate high concentrated travel demand especially at the event closing, when all attending people are simultaneously departing. This kind of event situation is studied in this paper. The idea is to coordinate the departing time so to keep traffic flow at a high level without reaching capacity and so avoiding queues.

## **3. Discrete/recurring event parking problems and applicability of ITS systems**

The high concentrated travel demand rates attracted by this kind of event create many problems at various levels and it may become necessary to plan traffic control and pedestrian access. ITS solutions can be applied to assign automatically parking lots to drivers (by means of internet or mobile phone ticketing) and in traveler information systems. Some ideas are briefly presented in this section.

Automatic parking lot assignment can contribute to distribute traffic flow more efficiently and optimize traffic flows on each single road access.

The transmission of information on mobile phones creates the

possibility to apply new advanced traveler information system that can be very useful for parking management. With this kind of systems information can be accessed before or during the trip by the use of mobile phones data transmission capabilities.

Moreover the use of data transmission on mobile phones allows to accommodate money exchanges and to collect parking fees electronically.

Some of these systems are already being implemented like the one introduced in Finland by Voicebit. The system is called NextPark and allows customers to pay parking fees directly with mobile phones. More similar systems are also already in use in many Italian towns.

Some other parking facilities are also introducing electronic payment with the use of a radio transponder on board that can be identified at the parking entrance.

All this electronic payment systems bear the potential to reduce service times at the parking entrances and at the same time reduce parking managing expenses.

Another useful ITS system is the application of parking guidance systems, these systems adopt VMS to give drivers information regarding parking availability and directions. These systems need to combine traffic monitoring, communication, information processing and VMS technologies. The availability of parking spaces can be obtained from detection of cars entering and exiting and/or by ticket issued. Many advanced Parking Management System have been implemented that are based on automatic traffic detection and traveller information systems at some airports and in some other locations. These systems can automatically give information concerning parking location, routing directions and occupancy status. Many cities have already installed electronic signs to inform availability of parking spaces with electronic variable message signs (VMS).

#### **4. The proposed solution for discrete/recurring event: Inverse Parking Pricing Policy (IPP) and ITS systems that could help in an implementation**

In this paper an inverse parking pricing policy is evaluated in a proposed scenario.

ITS systems can help to implement this policy and the policy is evaluated from the point of view of traffic flow management.

A simulation model has been used to compare different scenarios and assess the benefits obtained in term of reduced emissions and reduced travel times.

The ITS systems that could help the implementation of the proposed parking policy are:

- mobile phone data transmission;
- electronic payment;
- route guidance by means of on-board devices or VMS;
- planned scheduled departure times.

Planned scheduled departure times can be applied by introducing planned delays at each parking lot after the end of the event. This measure involve the deliberate delaying of time departures from chosen parking lots with the result of reducing congestion on bottlenecks. Travellers are informed in advance of this kind of restrictions that can be encouraged with a special parking fee management structure and with a proper offer of shopping or restoration services that can keep visitors busy as they wait for the proper time of departure.

The special parking fee structure that has been developed is an Inverse Parking Pricing Policy (IPP).

The definition of Inverse Parking Pricing Policy (IPP) is completely original and means decreasing parking fees for longer parking times (decreasing in absolute value not in rate).

This proposed parking price policy is intended to increase later departures after the end of an event. The contemporary departure of users at the end of a discrete/recurring event at a permanent venue causes an enormous amount of delay in travel times when traffic oversaturates bottlenecks. Since the desired time of departure is exactly the end of the event for all users, those users scramble for the exit roads causing queues that can last for very long period of times. Only a small time window in which users can incur in no delay exists and all users compete (most of them unsuccessfully) to exploit that very limited resource. In fact only some random lucky drivers actually manage to get right away past the bottleneck while others incur in an enormous traffic congestion and participate in a congested system environment with elevated levels of pollutant emissions.

The intended results of IPP policy are to:

- reduce traffic jams and densities;
- reduce queues entering/exiting parking lots;
- reduce exhaust emission (CO<sub>2</sub>, NO<sub>x</sub>, CO, particulate matter and volatile organic compounds.);
- reduce fuel consumption.

To clarify how the IPP policy could be applied and how the users could accept and conform to this payment policy a preliminary experimental survey has been carried out and results have been applied in a case scenario that has been simulated by using a within-day dynamic and day-to-day dynamic assignment model.

## **5. An experimental survey**

An experimental survey has been carried out to establish the willingness to pay and to delay departure time among special event participants.

The experimental survey has been carried at the University of Calabria campus by Stated Preference (SP) interviews conducted in a face to face interaction with the interviewers. There was no written module to read or compile and 100 students have been interviewed. All interviewed students were car drivers with a good knowledge of the transportation network and were chosen randomly among university parking lots users in which the interview was conducted. A realistic special event scenario was described to them. In this scenario a special event would occur in some specific and well known point of the network and they would have to choose between three different alternatives involving three different values of the following attributes (each student was facing three different scenarios, so a total of 300 scenarios was used in the interviews):

- departure time;
- travel time to exit the local road network (time mostly spent in queuing);
- parking fee.

The values that have been used in the proposed alternatives were chosen as follows:

- departure time from 0 to 30 minutes after the end of the special event