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### INNOVATIVE SOLUTIONS TO FREIGHT DISTRIBUTION IN THE COMPLEX LARGE URBAN AREA OF ROME

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## ABSTRACT

### OBJECTIVES

Around the world, concerns about the efficiency of the distribution practices and the impacts of freight vehicles on traffic congestion and environment are causing interest in urban and metropolitan goods transport to rise. An efficient freight distribution system is needed; it plays a significant role in the competitiveness of urban areas and is itself an important element in the urban economy, both for the income it generates and the employment levels it supports. The present project was developed in 2008 and 2009 to propose methods and models for the design of innovative solutions for urban freight distribution. Its specific objectives were to gain knowledge about implementation processes during introduction of new urban freight solutions, to develop freight transport models, and to define and validate solutions to freight transport in the complex urban area of Rome.

### MAIN FINDINGS

#### ▪ CURRENT INTERNATIONAL BEST PRACTICES IN THE FIELD OF URBAN FREIGHT DISTRIBUTION

An international desk research provided a clear understanding of the most common applied measures and methods related to urban freight transport. These can be classified in six categories: fiscal measures; regulatory measures; land use planning measures; infrastructural measures; new technologies and ICT measures; management and other measures. The possible impacts of the different measures on each actor involved in urban freight distribution have been assessed. The role of public and private actors was defined for each step of the policy planning and implementation process. This highlighted the need to involve all the actors in the planning and implementation process of a measure. In addition, the importance of applying not just one specific measure but rather of considering the application of packages of measures was understood. An international survey of best practices, mostly in Europe, revealed some issues to consider when judging the positive or negative effects of a measure, especially its transferability. Among these, the importance of considering consultation methods, such as the Freight Quality Partnership in UK, is a critical factor for deciding and evaluating the implementation of a measure. An in-depth study of some 30 European cases provided suggestions for the case of Rome in terms of practicable solutions and implementation process for specific measures.

#### ▪ SURVEY ON THE CURRENT STATUS OF FREIGHT DISTRIBUTION IN ROME AND THE SETUP OF THE FREIGHT QUALITY PARTNERSHIP

Two samples of operators were interviewed. The first derived from the commercial activities (e.g. retailers, shopkeepers, HORECA operators) located in the centre of Rome and the second from the transport operators involved in freight distribution. This survey was also supported by traffic counts in cooperation with the Mobility Agency of the Municipality of Rome (ATAC). Data gathered concerned: traffic flows by type of vehicle; types of goods transported; hourly distribution of delivery times; pickup and delivery issues; frequency of deliveries; use of loading space; origin and destination of deliveries; routes.

#### ▪ FREIGHT TRANSPORT MODELS FOR APPLICATIONS IN URBAN AND METROPOLITAN AREAS

A modelling system has been developed in order to estimate quantities, deliveries and vehicles used to restock shops, for each considered type of goods, within the study area. Three levels have been considered: commodity level, in which the freight O/D matrices in quantity are estimated starting from socio-economic data; delivery level, in which starting from the freight O/D matrices in quantity, the model gives the flows of deliveries for each O/D pairs; vehicle

level, in which the delivery flows are converted in vehicles, and, thus, the O/D matrices in freight vehicles are estimated.

Before the calibration and validation of the modelling system, the ex-ante evaluation with a Freight Quality Partnership (FPQ) was conducted and contributed to assessing the intervention policies for the freight limited traffic zone in the city centre of Rome. The technique used allows testing ex-ante the potential for consensus (cooperative outcomes) among both demand (shopkeepers) and supply (freight transport providers). The innovative aspect is the contemporaneous quantitative accounting for both demand and supply instead of, as it usually done, studying the two aspects as separate phenomena. In this respect it proves a complementary approach to the more widely used FQP. Several meetings with experts and stakeholders have been held in Rome. The following issues emerged from the meetings as the most apparently problematic: loading/unloading bays (number, frequent illegal occupation, architectural problems); access to the LTZ area (presence/absence of privileged treatment and exemptions for specific categories of users); hours and cost of access (exemptions); load factor of deliveries (lack of control of own account load factors); reserved lanes for goods transport (hypothesis of introducing reserved lanes); urban distribution centres (placement and functions). Additional problems raised by the agents are: collecting and processing of data – flows and movement (uncertainty about current conditions, no timely update of data); correspondence between long-term plans and short-term projects (regulatory plan, territorial plans, plans considering people and goods movements); traffic flows and sharing of the city (including the preservation of open space, lack of involvement of certain actors in planning, and normative simplification for operators). A questionnaire survey on the involved experts assessed the five most important policies for the case of Rome: incentives to buy vehicles with higher environmental standards; real-time information on loading/unloading bay reservations; incentives to using alternative propulsion systems; control of the illegal use of loading/unloading bays; promotion of the Multimodal Urban Distribution Centre for specific types of goods.

#### ▪ CALIBRATION AND VALIDATION OF THE MODELLING SYSTEM TO THE CITY OF ROME

The modelling system has been calibrated and validated for the city of Rome. Seven freight types have been considered (foodstuffs, home accessories, stationery, clothing, building materials, household and personal hygiene, other goods). Such models allowed to reproduce the actual situation of freight transport in the city of Rome.

Different scenarios have been built and simulated, then used to validate the modelling system and to give elements to the ex-post validation of the solutions performed subsequently: non-intervention and vehicle demand growth following the previous trend (+1.6%) without enforcing the control access; intervention and enforcing control for access to pre-Euro vehicles and for parking; access prohibition to vehicles that do not comply with the Euro 2 standards and market entry of Euro 5 standards; previous scenario with the creation of an Urban Distribution Centre (UDC). The effects of the different scenarios were evaluated in terms of CO<sub>2</sub> emissions, external costs, and productivity (vehicle-km), and the different scenarios were compared with a cost-benefit analysis, that showed, by example, the economic convenience of a UDC.

#### ▪ VALIDATION AND CONTRIBUTION TO FUT PROGRAMME

The ex-post validation of the solutions identified and modelled was conducted by means of an innovative agent-specific analysis. A main insight from this line of research is that, lacking the proper understanding of the relations established between agents, we will not be able to engage in the type of institutional design that can ensure collaboration, or at least decrease inefficient interaction, which can bring about external costs. Also, ignoring interaction and distribution of power within the urban logistics chain makes it difficult to predict reactions to policy shifts. The data acquired allowed for the estimation of agent-specific models that were useful for analysing the most promising and potentially acceptable policy mixes. The results obtained are not only reliable but also relevant under a policy implementation and evaluation scenario. The main accomplishments of the research are: the identification of the most important problems of the limited traffic zone in Rome for the main stakeholders; the acquisition of stakeholder-specific judgements concerning the present regulatory framework; the enumeration of potentially feasible and relevant policies based on stakeholders' problem-perception and preferences; the identification of an agent-specific utility for policy attributes; the definition and evaluation of potentially acceptable policy intervention measures and policy-mixes. Since, to the best of our knowledge, no study has acquired the necessary data to

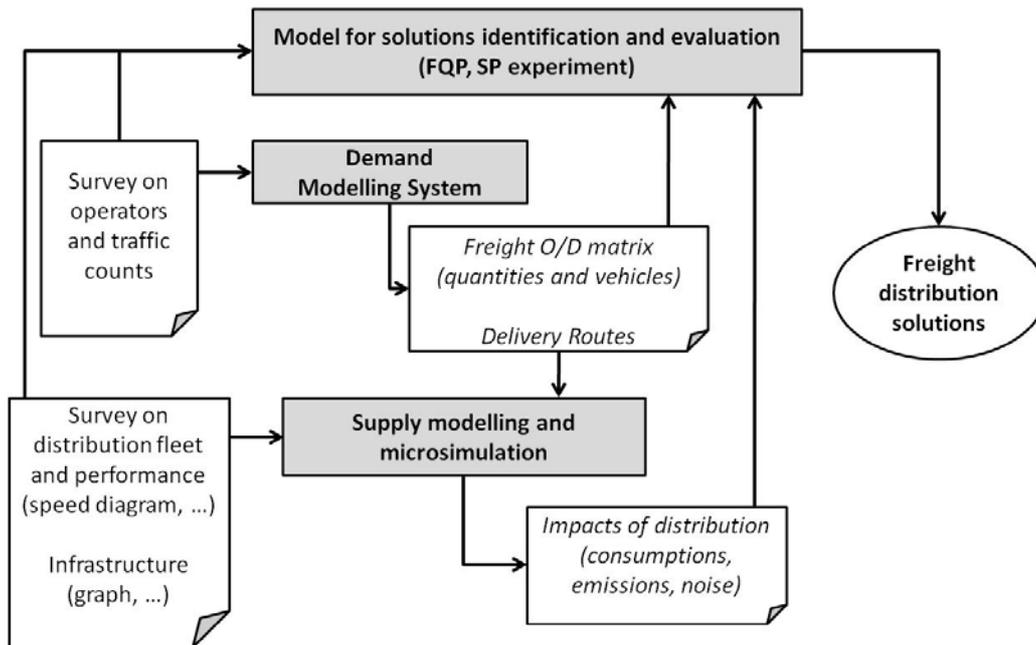
formulate analytically sound and empirically verifiable proposals incorporating knowledge of agent-specific behaviour, the analysis conducted in the project is the first attempt carried out to define and validate agent-specific freight analysis and policies.

The project contributes to the FUT programme mainly as follows:

- the methodology developed involves a cooperation mechanism (FQP) to find and implement urban freight transport solutions; this is in line with the cooperation and holistic view to face complex problems highlighted in the FUT 2009 conference;
- the overall results of the project are being disseminated within proper bodies (e.g. mobility agencies, stakeholders associations) and also are being used in academic courses for future transport engineers and economists; this is in line with the need to diffuse knowledge on sustainability (FUT conference 2009).

## CONCLUSIONS

The results of the project range from models to evaluation techniques. The integration of these results leads to an overall system that can be used as a decision support system for those involved in urban freight distribution in order to identify and evaluate policies and measures. This result has a general value that makes it transferable to any urban context. Here follows a conceptual functional diagram of such a system.



The grey boxes represent the main product of the project. Note that together with the supply modelling a microsimulation system has been introduced in order to calculate the impacts of the distribution. This constitutes an additional innovation the applicant introduced in the project. In fact models need to be integrated with actual measures of the phenomena they intend to represent in order to be effective to solve problems. To do this, in 2008 the research team equipped a small fleet of distribution vehicles in Rome with onboard terminals to measure vehicle behaviour (routes, speed, consumptions, use of operating time, etc.) during distribution operations. This allowed calibrating the microsimulation system and consequently improving the overall system thus providing the decision makers with a more accurate estimation of the impacts of the freight distribution system.

The resulting overall methodology contributes to the ongoing study on “Guidelines for city logistics plan”, a national research project funded by the Italian Ministry of Education and Research, coordinated by Prof. Filippi.