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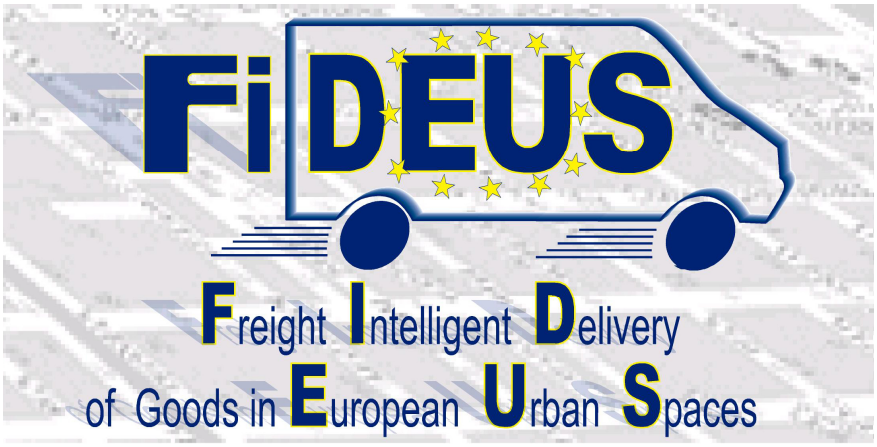

D6.3
PROJECT FINAL REPORT
VERSION 2.0

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Abstract: This document aims at summurazing the activities performed and the results achieved in the FIDEUS project. In particular, the proposed approach is described as well as the solutions that have been implemented. Finally, the test site activities and evaluation outcomes are presented.

Keywords: FIDEUS, city logistics

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LIST OF ACRONYMS

ADAS	Advanced Driver Assistant System
CF	Compact Flash
CNG	Compressed Natural Gas
CUV	Commercial Urban Vehicle
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global System for Mobile Communication
EEV	Enhanced Environmentally-friendly Vehicle
EPC	Electronic Product Guide
ETSI	European Telecommunications Standard Institute
EZEV	Equivalent Zero Emissions Vehicle
HMI	Human Machine Interface
LEZ	Low Emission Zone
OBU	On-board Unit
ONS	Object Name Service
PDA	Personal Digital Assistant
POI	Point of Interest
RFID	Radio Frequency Identifier
SOAP	Single Object Access Protocol
UDT	Urban Delivery Truck
UDV	Urban Delivery Van
VRU	Vulnerable Road User
WPAN	Wireless Personal Area Network

CONTENTS

1 Project overview

1.1 Needs overview

Urban logistics and delivery operations constitute a vital aspect of the functioning of European cities, supplying local trade and commerce, as well as residents, with essential goods for their daily needs and business. On the other hand, freight transport is both a contributor to and victim of the growing congestion threatening to choke urban mobility, and exposing large parts of the population to unacceptable level of noise and exhaust emissions.

While until 1990 city transport and mobility policies concentrated on passenger transportation, since the nineties this focus has switched to urban freight transport and professional trips. On this subject, statistics provided by the European Union highlight that in the last fifteen years freight volumes increased faster than economic activity. If no measures are undertaken in the future, statistics show the risk of a continuous increase in traffic volumes, that will be due in part to freight flows (about 20%). Such a situation affects the quality of life as well as the environment, and for freight transport itself means a loss of efficiency. Because of the traffic, today 'illegal' solutions are adopted for deliveries with respect to the traffic regulations. Double parking, for example, is often an obliged choice for vans and lorries that enter cities.

The present situation, which has evolved over the past decades, is unsatisfactory from a societal and environmental as well as an economic perspective. Both industry and city authorities are therefore faced with the challenge of bringing about tangible improvements, by proposing efficient means of transport, new technologies and mobility management policies, which will permit a more efficient organisation of urban goods transport.

Today's solutions often include Low Emission Zones, that aim to reduce vehicle emissions in a given area: only vehicles meeting certain standards are allowed to circulate in the LEZ. Access control and road pricing are further possible measures that affect all vehicles. Finally, the logistics is affected by restrictions on the size and weight of freight vehicles and on loading/unloading time. Only in the last few years experimental initiatives are going towards a positive approach, in which public authorities offer ad hoc facilities like freight villages or reserved lanes.

1.2 Objectives and approach

FIDEUS, a project co-funded by the European Union within the 6th Framework Program, is an initiative that started in May 2005 and proposes a new approach to the freight delivery through three types of actions:

- the development of a complementary set of vehicles and equipment, specially conceived for undertaking urban deliveries and collection;
- the proposal of new approach to the organisation of urban logistics, involving the co-ordinated use of different vehicle types, an innovative goods container, and support systems to improve the management of delivery operations;

- the provision of tools and information able to offer practical support to city authorities in planning and management of strategies for dealing with urban delivery traffic.

1.3 Project organization

The consortium, coordinated by Centro Ricerche FIAT, includes other OEMs like IVECO, Renault and ECA. Logistics world is represented by TNT and DHL, which have been supported by research institutions like University of Westminster, IMPACTS Europe and Fraunhofer IPK to focus on the policy aspects. Mizar Automazione has coordinated the implementation of a tool for the logistic management. Various combinations of the solutions have been tested in the three cities which belong to the consortium, that are Barcelona Municipality, Grand Lyon and Region of Hanover.

2 FIDEUS solutions

2.1 Overall solution

The FIDEUS partners have elaborated an overall solution in order to adapt the logistics chain in urban areas. Such a solution approaches the problem in an integrated way, by proposing a complete range of vehicles with advanced performances in terms of environmental impact, noise level reduction, ergonomics and safety. This new family includes three types of vehicles:

- a micro carrier, designed to move without restrictions and risks in pedestrian areas;
- a 3.5 ton urban delivery van, suitable to reach the downtown neighbourhoods also in case of traffic limitations;
- a 12 ton lorry, to perform especially large supplies.

A telematic tool enables the public authorities to publish on a web site all the traffic restrictions and to detect any violation from feeder vehicles. Moreover, logistics operators are now able to book reserved unloading bays. In order to test the impact of new technologies, RFID tags have been introduced to trace the main phases of the logistics process.

The proposed logistics flow is based on transhipment operations in those unloading bays, where the freight, unloaded from the main vehicles (van or lorry), is loaded on the Micro Carrier to be delivered to the final customers. This kind of operations is called “Cooperative transport”. The freight handling and the transhipment operations exploited a new generation, handy, secure, size/capacity effective container.

We also can talk about “direct supply” if big stocks are carried towards main customers (e.g. supermarkets or shopping centres) and directly delivered by the vehicle after the unloading operations. Finally, “parcel delivery” missions consist of delivering loose load, that means to avoid using containers and loading/unloading them.

2.2 Micro carrier

The Micro CUV is the prototype of a new vehicle concept implementing innovative technologies to meet new requirements for delivery and collection of letters and parcels in a dense urban environment associated with the “last mile”.
It is composed of three components: a tractor, a chassis and a container. The tractor is essentially constituted by an assembly of two drive wheels working at differential speeds, to give perfect control of the direction of movement and allow a standing turn. This solution also enables forward or reverse movement without requiring additional components. The two wheels are driven by two electric motors each controlled by a speed variator.

The power supply is provided by batteries. At present it is envisaged to use NiMH batteries. This is the couple that provides the best weight/volume/power/(total and immediate)/capacity compromise taking into account the envisaged traction function.
To handle this tractor in manual mode two handlebars are provided (“hand truck” type). These handlebars also provide support for the delivery man when he is standing on the “pocket container carrier” to drive it.
The chassis consists of :

- a hitching mechanism to be connect to the tractor;
- a mechanism to lift the "rear" wheels (at the connection point) to ensure maximum manoeuvrability and allow the “pocket container carrier” to clear obstacles on the ground such as dropped kerbs for example;

free-wheeling large diameter "front" wheels fitted with a pneumatic tyre (or equivalent) to ensure safe movement (in the urban environment).

2.3 Urban delivery van

IVECO Daily is a GVW 3.5 ton delivery vehicle that represents the best compromise between load (volume) capacity and size (in terms of land surface occupation).

It has been hardly modified to respond to the following needs:

- *Environmental impact*: its CNG propulsion meets the EEV/EZEV emission thresholds in urban context (post EURO5) at an affordable cost and can

guarantee low global level of CO2 emission thanks to its favourable Well To Wheel efficiency.

- *Noise level reduction*: with a CNG engine, external noise is considerably less than that of a diesel engine. With regard to urban traffic noise levels, the main sources under consideration are the engine, the road-tyres interaction and the impact noise when closing vehicle doors. At this purpose, a completely silent electrical door has been installed on the vehicle lateral side.
- *Ergonomics*: the interventions covered both the general handling of the vehicle and the loading/unloading operations:
    - Tail lift to load and unload the container without any effort for the driver;
    - An internal door installed to access directly the cargo compartment from the driver's cab;
    - Adequate light level in the cargo compartment;
    - Optimised size steps to get up/down the vehicle.
- *Preventive safety*: for this essential issue, several Advanced Driver Assistance Systems (ADAS) have been adopted. In particular:
    - An Electronic Reverse-Driving Assistance System has been developed to enable the so-called "rewind" function of steering actuation; the function allows automatic steering of the vehicle by controlling the Electric Power Steering system while the driver is controlling the vehicle speed;
    - a Blind Spot Monitoring system able to work also when the vehicle is parked, by detecting any moving obstacle;
    - a set of short range sensors to integrate the Blind Spot Monitoring system in order to detect approaching obstacles (pedestrians, cycles etc) and warn the driver before getting down;
    - rear camera and parking sensors;
    - a variable message panel to warn other vehicles on the manoeuvre in progress;
    - external spot lights for safety and security during night deliveries.

2.4 Urban delivery truck

The UDT, with a GVW of 12 tons, belongs to the medium truck class. Such vehicles are primarily required for palletised goods and larger cages, girder boxes or rolltainers. However, they also have huge potential as mobile distribution depots in the fringe of inner cities, and for combining several van tours into a single delivery trip. Despite their advantages for city logistics, trucks are at present scorned by most city authorities in favour of vans since they are considered too bulky, noisy, and dirty, and too hazardous for other traffic. New designs for UDTs which remedy these deficiencies allowed full exploitation of this vehicle class in advanced city logistics schemes.

All three vehicle types have been prototyped as precursors to industrial mainstream solutions, with a clear view to generating leading-edge products with sound market prospects in Europe, including the new accession countries, and indeed worldwide. The prototypes have been subjected to six months 'life-fire' operations with the logistics operators participating in FIDEUS in order to assess their technical, environmental, and economic performance, as well as to evaluate their potential to effect long-lasting improvements in European city logistics and the urban environment as a whole.

Advanced solutions have been investigated, developed and applied to a medium duty truck (12 tons) which fit with the requested overall features and scenarios of the global system, as provided from WP1 and WP2, in order to achieve the following objectives:

- A reduction of the environmental impact (noise and gaseous emissions);
- An excellent efficiency (high payload capacity);
- An improvement of the security for goods and driver
- A good access to the cab and to the goods
- The use of telematics tools according to WP

A series medium duty truck, equipped with a diesel engine having the best gaseous standard level, has been the basis of the vehicle. It provided a cost effective driveline for multipurpose applications in fleet operations. It provided the following elements:

- Noise reduction systems that allowed a low-noise mode in urban conditions and a bodywork treatment in order to reduce the noise during deliveries;
- Driver assistance systems (safety) to prevent accidents with vulnerable road users (pedestrians, cyclists): cameras, a special attention has been dedicated on HMI to reduce driver workload;
- Key-less entry and start coupled with the immobiliser function to facilitate the cab access and the security of the load during deliveries;
- A treatment of the bodywork to allow an easy access to the goods and the possibility to embark the Micro-CUV
- The integration of hardware and software functions to fully and satisfy the system
- requirements regarding vehicle-to-system interfacing: load/freight management, handling, and data processing.

2.5 Logistic management

Within FIDEUS, a telematic framework has been defined and implemented to improve the logistic management. Its specifications respond to the technical needs and requirements of the FIDEUS users:

- City authorities who require a tool to facilitate the management of areas with restricted access for delivery vehicles;
- Transport operators who require support in managing their delivery operations;
- Shippers who already have scheduling systems, but require additional services to support their operations in urban areas, including access booking for areas with restricted access and notification of entry into restricted areas.

This telematic framework is based on a remote control centre, which interacts with the FIDEUS vehicles through a SOAP interface and specific web services to collect and share the due information.

The telematic on board units consist of:

- embedded gateways for the vehicle-oriented functionalities;
- PDA with communication capabilities for the mission management;
- RFID reader for a precise management of parcels and roll containers.

3 Test site activities

The FIDEUS work programme included also a validation phase in three test sites: Barcelona, Hanover and Lyon.

3.1 Barcelona

The approach that has been followed has aimed to link the demonstration of the Renault truck with the ongoing programme of night delivery trials (this is explained later in this section).
The main use case is based on testing quiet night delivery operations with the 12T truck prototype in the framework of operator (Condis)'s current activities in Barcelona. The standard delivery time window for the use of reserved parking spaces in the city is from 8:00 to 20:00, so those considered night deliveries are meant to be realised during the remaining time, especially between 22:00 and midnight, and after 7:00 in the morning.
Basic data for a standard trip:

- Merchandise: dry goods (+ delicatessen and/or fruit)
- Time schedule: 23:00 to 00:00
- Frequency: daily (5 trips per week)
- Load (average): 7-8 T (19 combis[2])

Both the participating traders and the participating operators were in favour of access control restrictions which would oblige a greater number of the traders and operators to participate in the scheme (the surveys are of 16 of the 17 traders and 4 of the 5 operators). The proposed access restrictions would effectively reserve the preferred hours of delivery during mornings to electric and non-motorised vehicles (i.e. those from the transhipment centre), with exceptions for those products that cannot be handled at the transhipment centre (i.e. refrigerated foodstuffs).
Given the interest in being able to identify and monitor vehicles making food deliveries, it was proposed to amplify the FIDEUS demonstration in Barcelona to demonstrate a day-time direct delivery scenario (based on the same timing plan, but with a more intensive use of the vehicle by Condis). After confirming (the verbally agreed) scenario that would demonstrate the Renault truck serving the Condis supermarket located in the Sant Andreu district, a secondary scenario has been defined. The original route is basically the same (entering Barcelona) but ìthen the itineraire deviates to the left, entering Sant Andreu district (with a general 30 Km speed limitation) and arriving after short trip to the supermarket located at 58-60 Rubén Darío St. The typical normal journey is 16 km long and basic data is quite similar to the first scenario:

- Merchandise: dry goods (+ delicatessen and/or fruit)
- Time schedule: 19:00 to 20:00
- Frequency: daily (5 trips per week)
- Load (average): 7-8 T (19 combis)

Unlike the night delivery scenario, where a concrete, small, zone is defined to operate under the low noise mode, this scenario has not defined a zone for testing the low emissions mode but the whole itineraire from Condis depot to the supermarket and the way back. This way a longer distance has been defined, and measurements of emissions – and their expected benefits – have been optimised. Recently the sensibility of government – both local and regional – on environment has cause the implementation of a pack of measures including a 80 Km/h speed limitation in all roads (including motorways) 50 Km around Barcelona. This second scenario is therefore very interesting for the Municipality.

Also there is an added benefit since the route includes three different sections with three particular speed limits: 80 Km/h on the motorway from Condis depot to Barcelona, 50 Km/h from the entrance to the city until arriving Sant Andreu district and 30 Km/h for the trip indide this area.

3.2 Hanover

For the City and the Region of Hannover the objectives of the project were focussed on the assessment of the potential of new vehicle and logistics concepts with respect to finding new solutions to problems arising from emission-, supply-, safety- and security-problems, which result from an increased demand on regional commercial transport volumes. In doing so, the work and results from past and ongoing projects have been considered extended by the Fideus specific vehicle technological aspect.

To investigate different opportunities to cope with actual and future challenges:

- Traffic
- Pollution/climate
- Quality of urban living
- Economic growth.

The test site activity (August-September 2007) concerned three test cases:

- CityHub: use of a transhipment areas under the buildings of the city center (pre-sorted loading in hub according to round trip planning of MCUV);
- Urban Life: Van with FIDEUS container inside, sorted according to delivery chain, carrying of MCUV required (less space inside, handling)
- 2nd Lane: use of normal delivery van, without FIDEUS containers.

3.3 Lyon

The trial phase took place for a period of 1 month, between January 7th and February 8th. The truck was used by DHL to deliver goods in substitution to a standard 7,5t truck. The driver thus worked the exact same way than he would have with a classic truck: same clients, same routes, same handling of parcels and goods. Only some clients, implanted in the narrowest streets of Villeurbanne, could not be delivered with the FIDEUS truck. In these cases, the deliveries were made by other trucks from DHL.

- Double lane stops
  - No reservation of space test has been done, but a simulation of expected effects (time earned, emissions) of the systematic use of delivery areas (or any dedicated spaces).
- Optimizing routes
  - The use of a navigation tool (e.g. a GPS tool) during the test allowed the driver to optimize his route. The aim was either to measure or simulate the expected effects (time, emissions);
  - a simulation based on this route highlighted the additional benefit to earn from the dedicated use of bus lanes for delivery vehicles.
- Pollution reduction in the LEZ
  - The use of the low emission mode inside the LEZ allowed the vehicle to reduce its environmental impact when driving inside the zone.

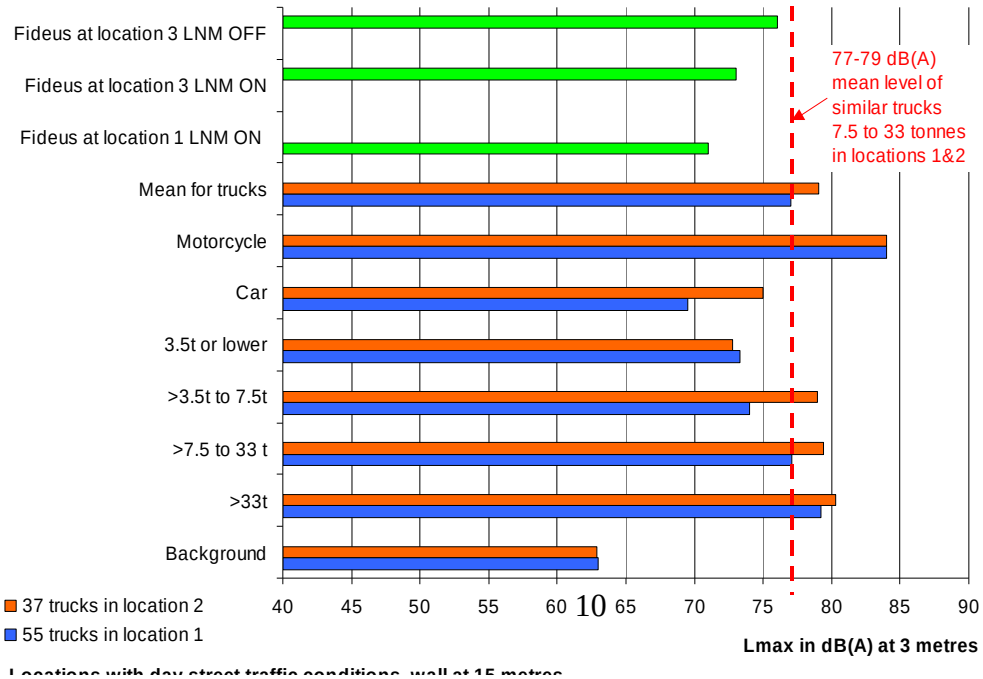
4 Main results

The overall results achieved during the FIDEUS project are positive and encouraging.

In **Hanover**, it has been possible to obtain an opening of the servicing time for the restricted areas so the access the zone after the curfew hours or to do the collection of goods in the afternoon without violating access restrictions was allowed.
The result was a reduction of effective delivery time even though the micro-carrier spent much more time in the pedestrian zone than a normal van. Indeed, the driver was often approached by residents and customers enquiring about the experiment.
On the whole, the operation was very efficient, with a high quality with a different logistics set up.

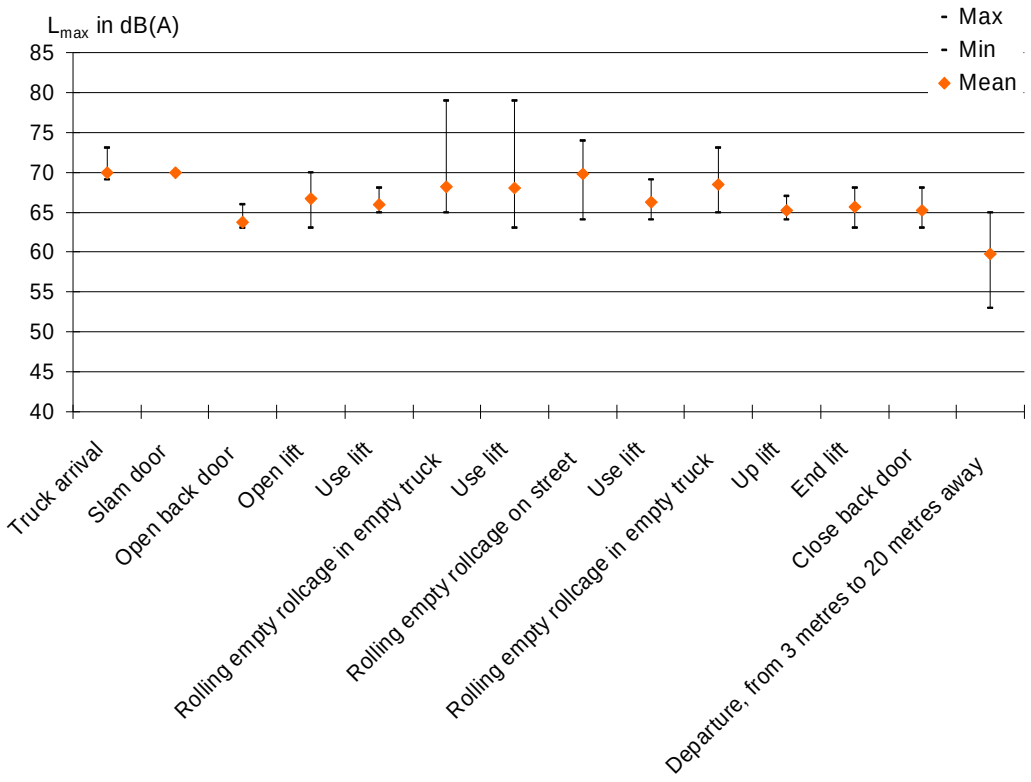
In Lyon and Barcelona, the 12 t Fideus truck from Renault was used for testing logistics options, aiming at reducing road freight transport externalities in cities: (i) a low noise night delivery scenario for allowing freight transport to city centre areas in the night, with far less traffic, (ii) a low emission scenario for entering a low emission zone in controlled situations, and (iii) a 2nd lane scenario to assess the impacts of 2 nd lane parking on traffic. The vehicle is a prototype truck. The new vehicle technologies features were tested in order to verify if they were effective in leading to a lower fuel use, a higher ergonomic adaptation to traffic and driver needs and lower noise. Therefore, the Fideus tests were a mix of policy evaluation, vehicle performance and impact evaluation, and logistics scenario impact evaluation. All tests were performed under real city traffic and real delivery conditions from January to March 2008.
The new vehicle technology of activated Low Noise Mode (LNM Barcelona) and Low Emission Modes (LEM Lyon) reduces truck noise and emissions significantly.
In Barcelona, the noise situation recorded with a pass-by test, with standard recording instrument at 3 metres and more than 800 measurements data, shows values of 73 dB(A), while other trucks of similar category were recorded at 79 dB(A) on average in the same situation (Figure 1).

Figure 1: Overview of noise levels for Fideus truck, compared to other trucks, vehicles, average and background noise, for the pass-by test



Compared to Hannover results of the impact of second lane parking on traffic, the Lyon test show much lower impacts of second lane parking on overall traffic and emissions was minor.
The vehicle shows a very good emission reduction record in Lyon. The activation of the „Low Emission Mode“, that obliges the driver to limit speed and acceleration, led to a net reduction of 5.9 litres/100km in average during the test days.
The noise record of Lyon showed a clear reduction compared to other trucks.
Different unloading operations have a noise impacts at the point of delivery, the records show a clear improvement by using low noise equipment with the Fideus truck compared to standard equipment and vehicles.

Figure 2: Noise of successive logistics and unload operations for the Fideus truck



The positive influence of eco-driving on emissions and noise were again clearly demonstrated with this test, and specific eco-driving recommendations were derived, among them to drive in 4th gear at 25 kmh or 45 kmh with activated Low Noise Mode or Low Emission Mode.
Best results for low noise were obtained in combining vehicle specifications with advanced equipments and ecodriving behaviour. It is advisable to continue to support cooperation between cities, science, constructors, forwarder and transport companies for evaluating the impacts of new policy measures and new vehicles and technologies on traffic, fuel use and noise under real business conditions.