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Feasibility and Transferability Analysis of energy-efficient and sustainable freight logistics solutions in Serres

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1. INTRODUCTION

1.1 Study Assignment

The present report is part of the project “Technical consulting services to the Municipality of Serres in the framework of ENCLOSE project (Development & Translation of Serres’ Sustainable Urban Logistics Plan)” which has been assigned to the Hellenic Institute of Transport (HIT) of the Centre for Research and Technology Hellas (CERTH) by the Municipality of Serres.

The objective of this project is to support the Municipality of Serres in developing for a Sustainable Urban Logistics Plan that is expected to have a positive effect on energy saving and on the reduction of air pollution caused by traffic.

1.2 General Information About the Project

The project is developed through two distinct technical actions

Action 1: Feasibility analysis and implementation of urban logistics measures

This activity involves an analysis of the potential application of urban logistics policy measures (candidate measures) and the selection of the measures to be implemented in the city of Serres in order to achieve energy saving and CO2 emissions reduction.

Action 2: Develop a Sustainable Urban Logistics Plan for the city of Serres.

In this action and through two distinct activities, the effects of the proposed urban logistics measures for the city of Serres, which will get implemented in Action 1, will be assessed and a Sustainable Urban Logistics Plan for the city will be developed:

- A. Evaluation and assessment of the benefits on mobility and energy during the pilot phase of the soft measures implementation in Serres. The evaluation will cover the pilot implementation of the soft measures and will include estimates of the expected results and benefits from implementing the proposed interventions under the specificities of the city of Serres.
- B. Development of a Sustainable Urban Logistics Plan for the city of Serres. This activity relates to the study in order to develop a Sustainable Urban Logistics Plan for the city of Serres.

The present, fifth deliverable of the project, relates to the first action, and more specifically to the final report of the feasibility analysis and implementation of urban logistics measures study.

1.3 Project Team

The project team consists of project managers and specialists in the fields of Sustainable Urban Mobility, Urban Logistics and Transportation Analysis and Design. The project team is composed by:

- Georgia Aifadopoulou, PhD. Civil - Transportation Engineer, Senior Researcher B at HIT, expert on freight and passenger transport networks.
- Aristides Halatsis, Civil - Transportation Engineer MSc, Senior Project Manager at HIT, expert on Urban Freight Transport and Logistics.
- Maria Morfoulaki, PhD. Civil - Transportation Engineer, Research Scientist B, HIT, expert on Sustainable Urban Mobility.
- Katerina Chrysostomou, Civil - Transportation Engineer MSc, Associate Researcher at HIT.
- Nilia Kotoula, Surveying - Transportation Engineer MSc, Associate Researcher at HIT

1.4 *Outline of the Feasibility study*

The feasibility study includes the following five main chapters:

1. Serres context (presentation of the study area, the road network characteristics and results of traffic surveys conducted).
2. General logistics context (presentation of the current situation of urban freight transport and logistics in the city of Serres)
3. Setting logistics baseline (presentation of results of the questionnaire survey addressed to shop owners and transporters)
4. Presentation of the results of the best practices benchmarking analysis of the preliminary feasibility study. Selection of the candidate measures that can be implemented in the city of Serres.
5. Feasibility of the selected measures..

The economy of the region of Serres is closely associated with agricultural and livestock activities. Agricultural and livestock products such as cereals, tobacco, rice, cotton, corn, vegetables, fruits, dairy products and others are extensively produced in the area.

The local industry is based mainly on agricultural products' processing but also on textiles and other industrial products. The most active sector seems to be food and wood products' industry.

On the outskirts of the city, 7 kilometres from the city centre and close to the vertical axis of Egnatia Odos, there is an industrial area, covering 1.2 square kilometres, where residential and office furniture, plastic production, agricultural equipment, beauty products, construction materials, etc. industries are located [4].

Also an important asset is the Technological Educational Institute (T.E.I.) of Central Macedonia that is located in the area, an institution which comprises of three faculties, seven departments and has more than 14,000 students. [5]

2.1.2 Main road network and identification of the study area

Since the seventies, the city of Serres faced intense urbanization, especially in the city centre. Open spaces were replaced by apartment buildings and a sharp increase in the ratio of private car ownership has been observed.

Today, due to the number of activities that are served in the area of the city centre (administrative, commercial and leisure activities), congestion problems are faced in most or part of the road network of the city and the city's ring road cannot effectively serve the traffic that is being generated.

The mobility conditions are getting even worse as a result of increased travel demand, lack of parking spaces and lack of space for other users of the network, such as pedestrians and cyclists.

In this context, freight transport is being carried out with significant obstacles, due to lack of coordination. All these, together with the increasing traffic of private vehicles, contribute to the urban environment burdening, energy consumption and air pollutants increase, visual and noise pollution.

Also, urban freight transport is responsible for occupying space, accidents' increase and pollution in urban areas. The lack of coordination of urban freight transport seems to intensify all these negative impacts.

All the above highlight the need to organize an optimal urban freight logistics management system implementing best practices, in accordance with the European vision for sustainable development.

The study area is located within the commercial city centre, where most commercial activities take place (e.g. hotels, restaurants, cafes, shops etc.). The exact study area is defined by the following streets: Dutikis Thrakis, Megalou Alexandrou, 20 Septemvriou, Ethnikis Antistaseos, Vasileos Vasiliou, Venizelou, Komninon, Thessaloniki and Kerasountos (Map 2.2).



Map 2.2: The study area in the centre of the city of Serres

2.2 Traffic Conditions of the Study Area

For the completion of the feasibility study, an identification of the freight transport system's problems in the city of Serres was conducted through a three step procedure.

At first, freight vehicles traffic volumes were measured in certain selected locations (junctions) of the region in order to gather information about how urban freight transport affects the road network of the study area.

Subsequently, a specific central axis of the city with intense commercial activity and required loading/unloading infrastructure was selected, in order all needs and requirements of the region of influence to be defined.

Finally, traffic measurements and parking characteristics survey were conducted, in order to derive useful conclusions regarding the operation of the road network, the congestion that the loading /unloading procedure can create as well as the problems occur from the occupation of the relative loading/unloading places from private cars.

The steps above are described in detail in the following sections.

Source: [6]

2.2.1 Freight Volumes Measurements

Freight vehicles volumes measurements were conducted in November 2012 during a typical day and during periods 7:00 to 9:00 and 13:00 to 15:00 which are the peak hours, as these

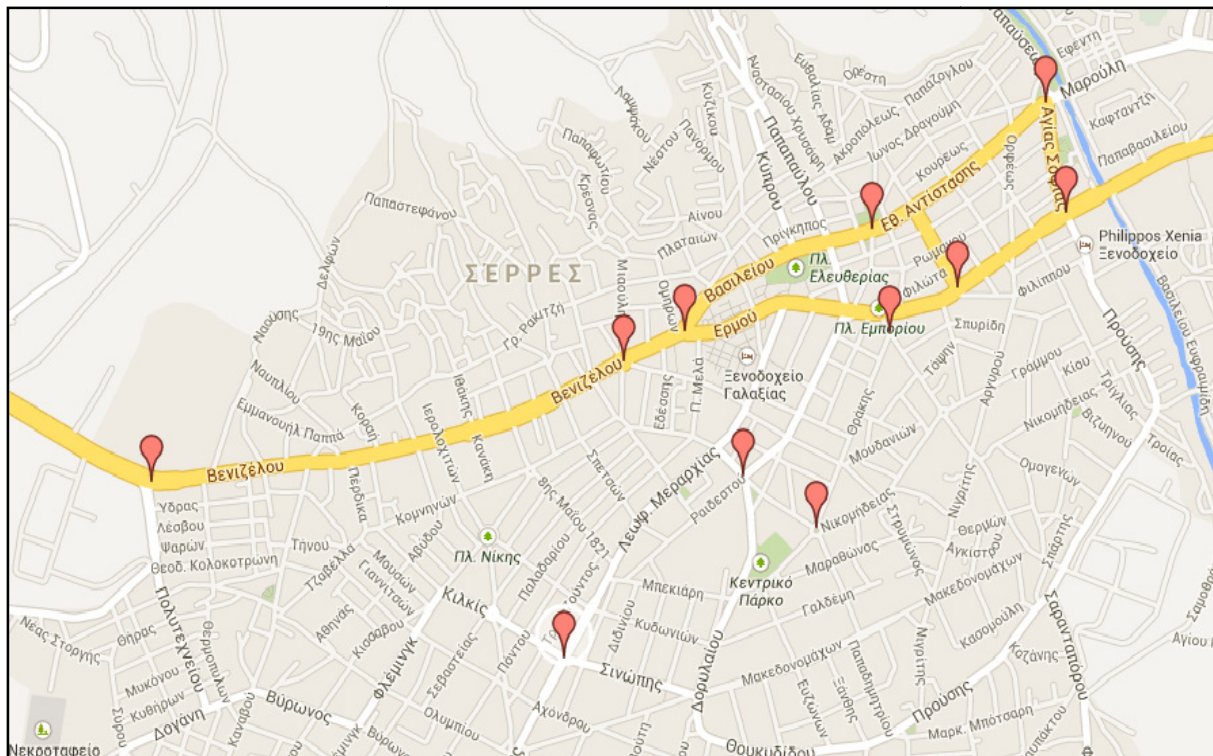
time periods coincide with operation hours of both public sector and shops. The following table (Table 2.1) presents the results of the measurements.

Table 2.1: Freight vehicles volumes

FREIGHT VEHICLES VOLUMES MEASUREMENTS IN SPECIFIC JUNCTIONS OF THE CITY OF SERRES			
		07:00-09:00	13:00-15:00
JUNCTION 1: AGIAS SOFIAS-ETHN. ANTISTASIS	Commercial vehicles	38	39
	Pickups >1,1tn	34	34
	Trucks >3,5tn	13	9
	Trucks >6tn	0	0
JUNCTION 2: ETHN. ANTISTASIS - KONSTANTINOUPOLEOS	Commercial vehicles	123	163
	Pickups >1,1tn	87	115
	Trucks >3,5tn	19	11
	Trucks >6tn	2	0
JUNCTION 3: AGIAS SOFIAS-MEG. ALEXANDROU	Commercial vehicles	67	80
	Pickups >1,1tn	29	30
	Trucks >3,5tn	14	12
	Trucks >6tn	4	3
JUNCTION 4: MEG. ALEXANDROU - 20 SEPTEMVRIOU	Commercial vehicles	89	87
	Pickups >1,1tn	46	58
	Trucks >3,5tn	35	21
	Trucks >6tn	14	1
JUNCTION 5: DIT.THRAKIS -KERASOUNTOS	Commercial vehicles	52	51
	Pickups >1,1tn	20	28
	Trucks >3,5tn	5	4
	Trucks >6tn	0	0
JUNCTION 6: DIT.THRAKIS-ANAT. THRAKIS	Commercial vehicles	43	52
	Pickups >1,1tn	42	27
	Trucks >3,5tn	11	5

FREIGHT VEHICLES VOLUMES MEASUREMENTS IN SPECIFIC JUNCTIONS OF THE CITY OF SERRES			
		07:00-09:00	13:00-15:00
	Trucks >6tn	0	0
JUNCTION 7: VAS.VASILEIOU-ERMOU	Commercial vehicles	40	124
	Pickups >1,1tn	22	70
	Trucks >3,5tn	22	9
	Trucks >6tn	19	4
JUNCTION 8: VENIZELOU -29 IOUNIOU	Commercial vehicles	12	74
	Pickups >1,1tn	27	40
	Trucks >3,5tn	15	13
	Trucks >6tn	2	0
JUNCTION 9: THESSALONIKIS-REDESTOU	Commercial vehicles	18	25
	Pickups >1,1tn	12	8
	Trucks >3,5tn	14	21
	Trucks >6tn	0	0
JUNCTION 10: MERARCHIAS-KILKIS	Commercial vehicles	10	10
	Pickups >1,1tn	39	38
	Trucks >3,5tn	27	31
	Trucks >6tn	5	
JUNCTION 11: VENIZELOU-POLITEXNEIOU	Commercial vehicles	51	73
	Pickups >1,1tn	40	47
	Trucks >3,5tn	20	8
	Trucks >6tn	13	5

The points selected for the measurements are also presented in the map below.



Map 2.3: Freight vehicles measuring locations

From the data above, it has been observed that most freight traffic passes through the streets: Ethnikis Antistasis, Megalou Alexandrou, Venizelou, Vasileos Vasiliou and Ermou.

2.2.2 Traffic Volumes Measurements

During the investigation about the main road network in the reference area, traffic volume measurements were conducted by the Hellenic Institute of Transport (HIT) staff during a typical day and more specifically on Thursday, October 24th, 2013 and for the period from 7:00 to 21:00. Measurements were conducted in two shifts, in the morning from 07:00 am to 14:00 pm and in the afternoon from 14:00 pm to 21:00 pm, at two specific points of Ermou Street.

Ermou Street was selected for the traffic surveys conducted, as it is one of the most important axis of the city because of its location and its interface with the network of pedestrian streets that has been recently developed and continues to expand, as part of the policy for sustainable mobility that has been adopted by the Municipality of Serres and its citizens. It is a shopping street, along and near which, there are plenty of shops. In addition, in different sections of the street, there is infrastructure of roadside parking zone whose status is not "clear" at the moment, due to lack of policing. Ermou street was selected as a typical example of a commercial road in Serres and the profile of traffic can be expanded for all the main axes of the city center.

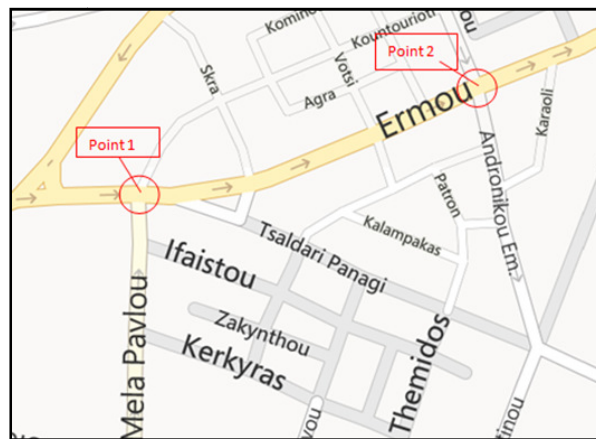
The measurement points are shown in the following Figures 2.1, 2.2 as well as in Map 2.3.



Figure 2.1: **Measurement Point 1: Ermou-Pavlou Mela**



Figure 2.2: **Measurement Point 2: Ermou- M. Andronikou**



Map 2.4: Location of the traffic volumes measurement points on Ermou Street

For each measurement point the movements shown below in Diagram 2.1 and Diagram 2.2 were studied upon. At each point three moves were recorded.

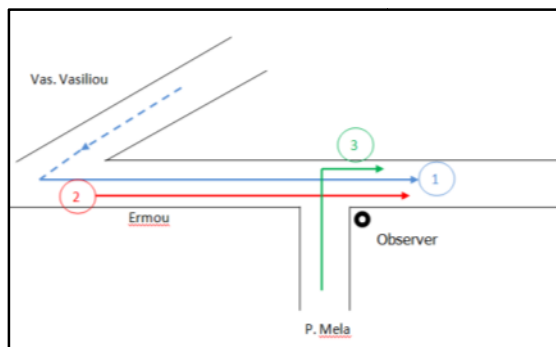


Diagram 2.1: **Point 1: Ermou-Pavlou Mela**

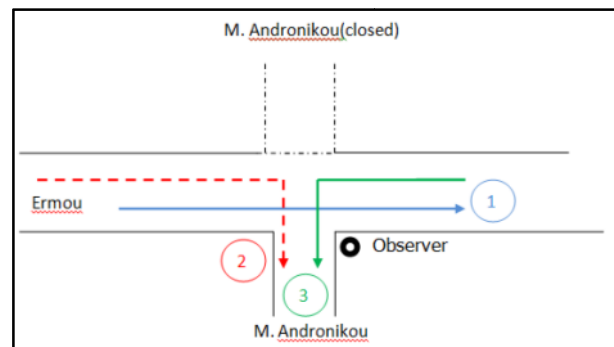


Diagram 2.2: **Point 2: Ermou- M. Andronikou**

The measurements were made using a special form and traffic volumes were recorded every quarter of hour. From the measurements, hourly totals by category of vehicle were

calculated and then they were converted in Passenger Car Units (PCU). Traffic volumes measurements are included in Annex A of the present deliverable.

According to the measurements (Diagram 2.3), most cars passing through Ermou street are private cars (73%). Motorcycles follow with 12% and vans (small and large) are each 5% of the total traffic volume. Finally, 2.5% of the vehicles are trucks and buses. In total, freight vehicles (large/small vans and trucks) constitute 12.5%.

Diagram 2.4 presents traffic volumes, as measured during periods 9:00 to 14:00 and 14:00 to 21:00 (morning and afternoon shifts respectively). As shown in the diagram, the percentage of private cars and motorcycles are higher in the afternoon split, whereas freight vehicles are more during the morning shift (17% versus 8% during the afternoon shift) as most distribution of goods is made during the morning.

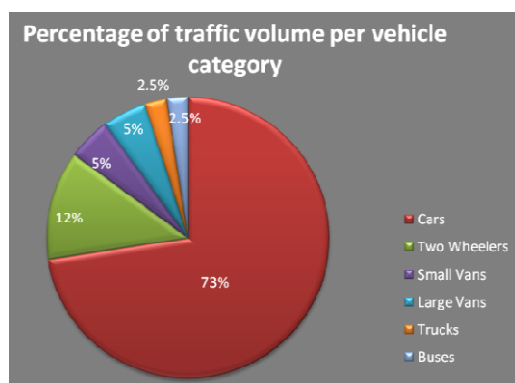


Diagram 2.3: Percentage of traffic Volume per vehicle category

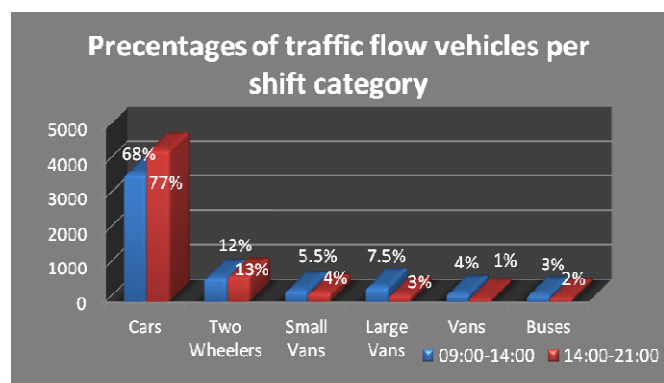


Diagram 2.4: Percentage of traffic volume per vehicle category and shift

An analysis of traffic volume counts resulted to the graphs that follow showing the hourly variation of traffic volume in both locations studied. In particular, diagrams 2.5 and 2.6 depict the hourly variation of traffic volume at measurement point 1: Ermou-Pavlou Mela and measurement point 2: Ermou- M. Andronikou respectively.

As shown in both diagrams, higher congestion levels have been observed in intervals 8:00 to 9:00 in the morning (shops opening hour), 14:00 to 15:00, when the shops close and owners and clients return to their homes and during 18:00-19:00 in the evening when the market afternoon shift starts. The lower traffic volume was observed during 15:00 to 17:00 when shops remain closed; while after eight in the evening traffic is considerably reduced.

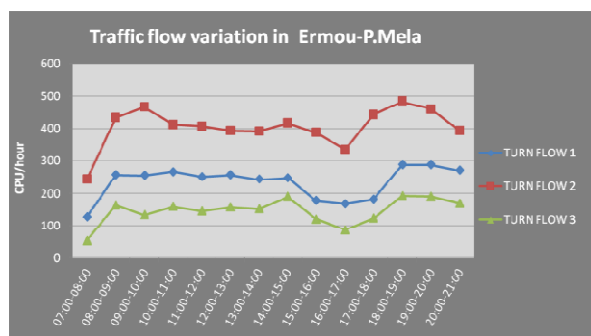


Diagram 2.5: Traffic Volume Variation in Ermou-P.Mela

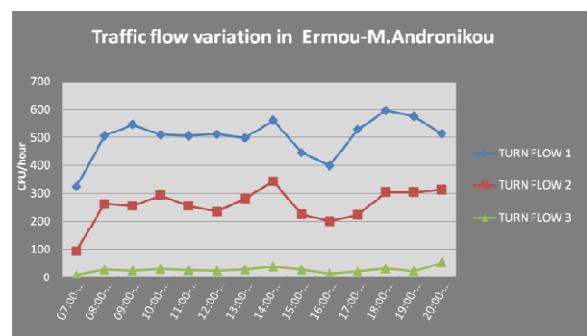


Diagram 2.6: Traffic Volume Variation in Ermou-M.Andronikou

Diagrams 2.7 and 2.8 depict the hourly variation of traffic volume of freight vehicles at measurement points 1 and 2 respectively. Small Vans, Large Vans and Trucks have been considered and hourly totals have been converted to Car Passenger Units (CPU).

As presented in Diagram 2.7 the peak hour for freight vehicles in the beginning of Ermou Street is between 9:00 to 11:00 am. Further increase is observed on movement 1 referring to vehicles entering Ermou Street from Vasileos Vasileiou during the periods 12:00 to 13:00 and 14:00 to 15:00. During midday, traffic is considerably reduced since stores are closed and during the afternoon shift, volumes stay at very low levels, since the largest part of distribution of goods is made during the morning.

Likewise, in diagram 2.8 the peak of freight traffic volume is during morning, while an increase in freight vehicles traffic volume that is observed for movement 2 during periods 11:00-12:00 and 13:00 -15:00. The vehicles involved in this movement are those that serve the pedestrian area and as loading and unloading spaces in Ermou Street are not sufficient, they enter the pedestrian streets to carry out distributions.

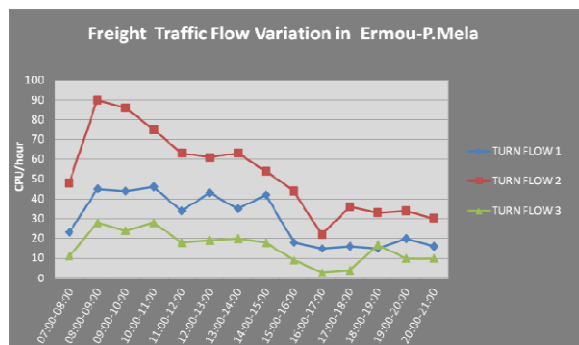


Diagram 2.7: Freight Traffic Volume Variation in Ermou-P.Mela

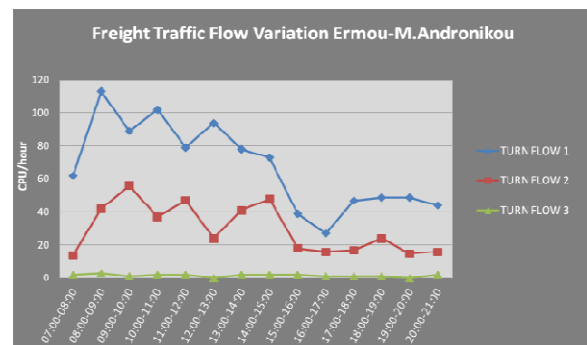


Diagram 2.8: Freight Traffic Volume Variation in Ermou-M.Andronikou

As regards congestion flow, it is expressed in Volume / Capacity ratio and determines the degree of congestion on a road section. For values higher than 1, the road segment is considered to be congested while values lower than 0.5 correspond to no particular problems. The capacity value of Ermou street calculated according to the Highway Capacity Manual is 800 vehicles / hour.

Table 2.2 presents the variation of the saturation flow in measurement points 1 and 2 respectively. According to the measurements and for the peak periods, the saturation flow is higher than 1 which leads to the conclusion that Ermou street is congested, the specific peak hours.

Table 2.2: Saturation flow in Ermou street

Point 1: Ermou-Pavlou Mela		Point 2: Ermou- M. Andronikou	
Peak hours	Saturation flow	Peak hours	Saturation flow
08:00-10:00	1.04-1.06	09:00-10:00	1.03-1.04
13:00-14:00	0.98-1.06	13:00-14:00	1.00-1.17
18:00-19:00	1.17-1.20	18:00-19:00	1.12-1.16

2.2.3 Parking characteristics of the study area

For identifying parking characteristics in the study area, a parking characteristics survey was conducted by the Hellenic Institute of Transport (HIT) staff, along with the traffic volumes measurements. The survey took place in two shifts, in the morning from 07:00 am to 14:00 pm and in the afternoon from 14:00 pm to 21:00 pm, along Ermou Street. The first step was current parking situation recording. All steps of data collection and parking characteristics analysis are presented in Diagram 2.9 and discussed below.

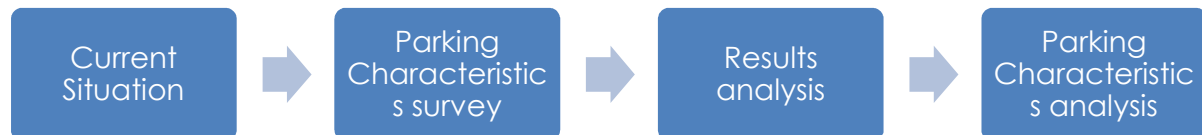


Diagram 2.9: Parking characteristics identification steps

For recording of the current parking situation along Ermou Street, the following actions were taken:

1. Street encoding.

The recording of data was made per block side. The street was studied and coded per block, and block side.

2. Recording of existing parking regulations.

For the most accurate recording of the current possible existing parking spaces were recorded according to the following classification:

- Illegal parking spaces
- Controlled parking spaces
- Loading and unloading spaces
- Special spaces (for vehicles of the Municipality of Serres)

3. Recording of the existing parking spaces along the street.

The recording was carried out by an experienced person who recorded with full detail all available spaces along the street, according to the Highway Code regulations. Table 2.3 presents the parking spaces per category.

Table 2.3: Existing parking Spaces along Ermou street

EXISTING PARKING SPACES ALONG THE STREET	
CATEGORY	NUMBER
Controlled Parking Spaces	13
Illegal Parking Spaces	43
Spaces for vehicles of the Municipality of Serres	3
Loading and Unloading Spaces	2

4. Recording of current parking demand.

Current parking demand is determined by the occupation of the available legal parking Spaces and the number of illegal parked vehicles. For this reason, the recording of parked vehicles during peak hours and working open hours of shops, offices, banks and public & municipal services.

All data were recorded on a form, as shown in Table 2.4.

Table 2.4: Existing parking situation form

PARKING ROTATION SURVEY											
Date : 24/10/2013		Day : Thursday		Interviewer name :				Page No :			
Route : Ermou street				Region : Serres centre							
Block Number	Side Number	Space	Parking Type (*)	7:00-8:00	8:00-9:00	9:00-10:00	10:00-11:00	11:00-12:00	12:00-13:00	13:00-14:00	COMMENTS

More specifically, the following elements were recorded:

- Parking restrictions per block side
- Number of Controlled Parking spaces
- Number of Special spaces (for vehicles of the Municipality of Serres)
- Number of Loading and Unloading spaces
- Number of illegally parked vehicles by category of prohibition:
 - o Parking restriction
 - o Parking in front of bin
 - o Pedestrian street Entrance/Exit
 - o Parking, Gas station, etc. Entrance/Exit
 - o 5m from pedestrian crossing
 - o 10m from junction
 - o 12m from STOP sign
 - o 12m from bus stop
 - o 20m from traffic light

Having completed the recording of current parking demand, along Ermou Street, the recording of parking characteristics survey followed.

The survey was based on recording in special forms the last three numbers of the license plate of parked vehicles. The recording was made every one hour starting at 07:00 am till 20:00 pm. The survey was conducted during a typical day, namely Thursday, October 24th, 2013; when the stores were open also in the afternoon.

Analysis of the data recorded followed in order to extract information about parking characteristics. For the analysis the following data used and calculated:

- Number of vehicles per parking category.
- Rotation index (vehicles/parking space).
- Average parking duration
- Duration with higher incidence
- Maximum accumulation

Vehicles parked in the study area are divided into two categories :

"Continuous Presence" (vehicles that did not move during the data collection period).

"Passing vehicles" (vehicles that arrived and left during the data collection period).

Thus, for the street studied the parking characteristics are presented below. More specifically the following are presented:

- Summary tables of the street's parking characteristics
- A diagram of the distribution of accumulation

Based on the above, a correlation can be made between the parking characteristics and other elements that will lead to conclusions, related to the relationship between land use of the study area and parking rotation, or parking duration and accumulation of legal and illegal parking.

In the following tables (2.5 and 2.6) the general characteristics of the route along Ermou Street are presented.

Table 2.5: General parking characteristics of Ermou str

General Parking Characteristics of Ermou str					
	Controlled parking	Illegal parking	Double-parking	Special spaces	Loading and unloading spaces
Total Number of spaces	13	43	-	3	2
Total number of recorded vehicles	53	123	38	10	6
Number of vehicles that did not move	1	-	-	-	-
Percentage (%)	1,89%	0%	0%	0%	0%
Number of vehicles arrived and left (Passing vehicles)	32	123	38	10	6
Percentage (%)	60,38%	100%	100%	100%	100%
Number of recorded vehicles with a fine	-	-	-	-	-
Parking Duration					
Average parking duration (h)	2,92	1,86	1,29	1,3	1,5
Parking duration with higher incidence (h)	1	1	1	1	2
Percentage (%)	43,4%	66,67%	92,11%	80%	50%
Parking duration with the second higher incidence (h)	3	2	2	3	1
Percentage (%)	16,98%	12,2%	5,26%	10%	50%
Parking duration with the third higher incidence (h)	2	3	10	2	0
Percentage (%)	16,98%	8,94%	2,63%	10%	0%

Table 2.6: Parking accumulation and rotation characteristics in Ermou str.

Parking accumulation and rotation characteristics in Ermou str.					
	Controlled parking	Illegal parking	Double-parking	Special spaces	Loading and unloading spaces
Vehicle accumulation					
Time period with the maximum accumulation (h)	08:00	20:00	20:00	08:00/19:00	10:00/11:00/13:00/14:00/16:00/19:00
Maximum accumulation (veh)	10	16	7	2	1
Parking rotation according to the number of available parking spaces					
Rotation index (vehicles/parking space)	4,08	2,86	-	3,33	3
Hourly rotation index (vehicles/parking space/h)	0,29	0,2	-	0,24	0,21

From the analysis of the parking situation along Ermou Street, the initial conclusion that emerged was the lack of policing. Controlled parking spaces are used illegally (without the necessary ticket) as shown by the results of the survey. The duration parking on the controlled parking spaces is on average three hours.

Similarly, the average duration of illegal parking is 2 hours and of double-parking 1.5 hour. The loading and unloading spaces are occupied by vehicles not distributing goods as out of the 6 vehicles that were recorded only one was legal, while five were illegal. Respectively, special parking spaces, where only vehicles of the Municipality of Serres are allowed to park, were occupied by other vehicles

Rotation index was 4.08 for controlled parking spaces, 2.86 for illegal spaces and 3 for loading and unloading spaces.

The accumulation diagram shows that there are morning and afternoon peak hours. According to the accumulation of illegally parked and double-parked vehicles demand is high at specific times, namely 8:00 to 10:00 am, 13:00 -15:00 pm and 17:00 to 19:00 mm. A number of double-parked vehicles refer to trucks for loading and unloading since dedicated spaces were continuously occupied.

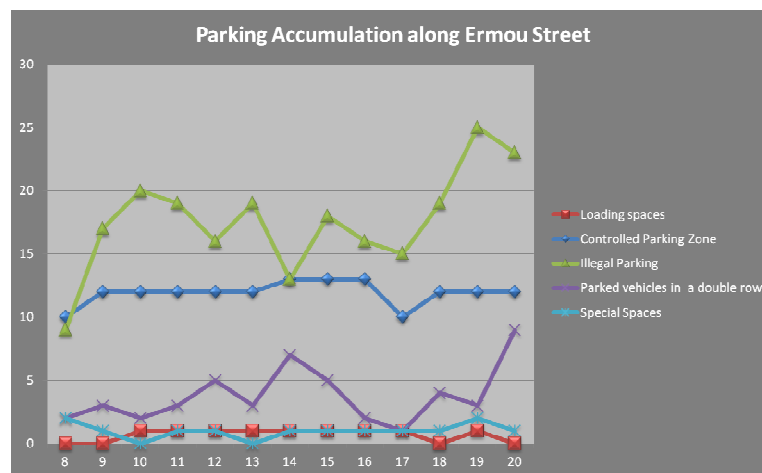


Diagram 2.10: Parking accumulation along Ermou Street

2.3 Highlight Traffic Problems

The three step procedure followed above revealed some significant problems concerning the city's road network functioning.

The freight vehicles traffic volumes measured in certain selected locations of the reference region revealed that there is a significant number of freight vehicles affecting all main axis of the city's road network. There are time periods during the day where low speeds and time delays are observed due to the distribution procedure. These periods are between 7:00-11:00 in the morning.

Traffic volume measurements showed that the higher congestion levels are observed between 8:00-9:00 in the morning, 14:00-15:00 and 18:00-19:00 in the afternoon. These time periods correspond with the city's commercial activities.

As regards the congestion flow, the Volume / Capacity ratio which determines the degree of congestion on a road section, is higher than 1 during the peak hours, leading to the conclusion that main axis of the road network are congested during these hours.

The analysis of the parking situation revealed that there is an immediate need for the enforcement of strict policy measures to both controlled parking spaces and loading/unloading spaces, as phenomena of illegally parked vehicles and of double parked vehicles (including vans and trucks) along the streets are observed all the time. The occupation of the relative loading/unloading spaces from private vehicles prevents the proper functioning of the road network, as transporters are forced to cover extra distances within the city centre, until they find a free place to park.

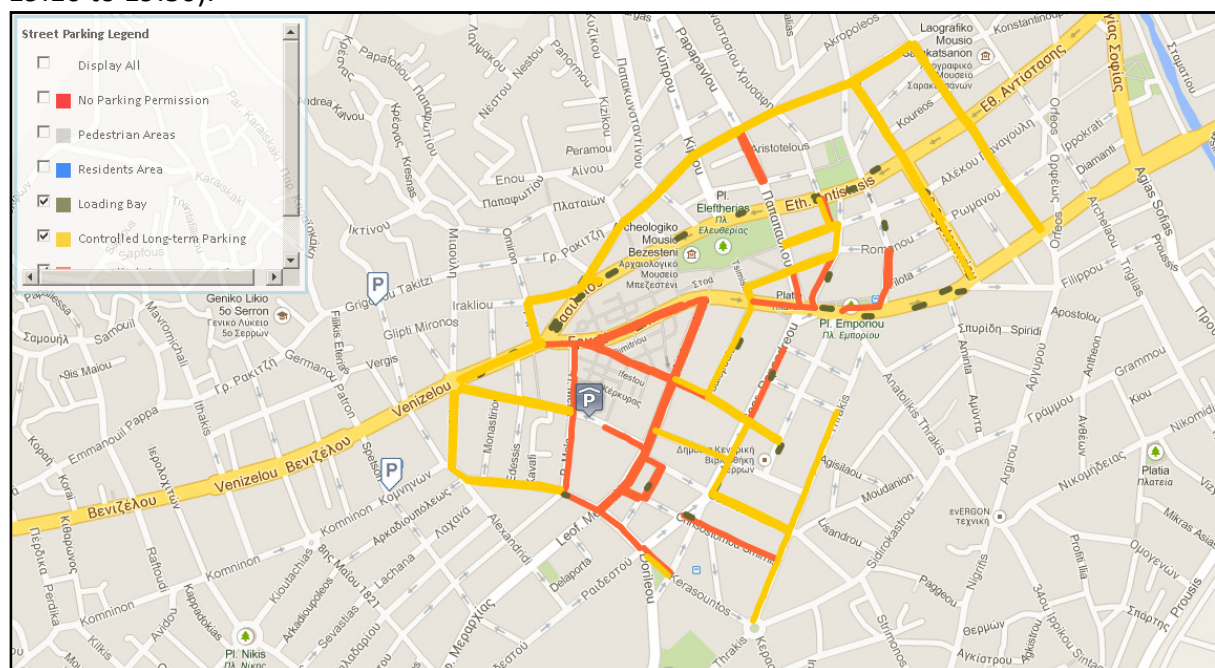
Finally, drivers' behaviour and illegally parking in the loading and unloading spaces highlight the lack of public's information on the importance of the proper operation of these spaces without restrictions, the need to raise awareness on sustainable mobility issues and to realize the problems they pose with their illegal behaviour

3 SETTING LOGISTICS BASELINE

3.1 Current Situation of Urban Freight Transport and Logistics in the City of Serres

Urban freight transport is considered to be essential for the proper functioning of a city, and to facilitate it, the Municipality of Serres has assigned specific loading and unloading places within the commercial centre of Serres with the intention to be used only for this purpose. Thus, less than 30 loading/unloading places are being upgraded (the exact locations are presented in Map 3.1.) while in the near future, more are expected to be constructed in the framework of a study of urban and bioclimatic reconstruction near the city centre.

According to 619/2002 Regulatory Decision of the Municipality, places in pedestrian zones can be used by freight vehicles distributing goods during 7:00 to 10:00 in the morning and 14:30 to 17:00 in the afternoon (14:30-18:00 during summer). The maximum load allowed is 3.5 tons. Under other regulatory decisions (e.g. 902/2009), loading and unloading places have been also assigned to private companies for specific time intervals (7:20 to 7:45 and 19:10 to 19:30).



Source: [6]

Map 3.1: Loading and unloading places in Serres city centre

In addition, previously among the plans of the Municipality was the establishment of a logistics centre that could be located inside a “Large Vehicles’ Parking Lot” owned by the Municipality that is located by the new suburban road and more specifically at Krinos junction. In this location, the Municipality aimed to create, among others, organized storage spaces by building a warehouse of about 1,000 square meters to serve carriers. In the context of these plans the company AFETIRIA SA was founded.

The decision of the municipality, to establish this business, was a result of an effort to achieve security, improve aesthetics and reduce pollutants in the city centre by reducing the number of large vehicles circulating in the city. Unfortunately, various circumstances lead to a problem performance and currently financial checks take place while even the dissolution of the company, is being considered. The infrastructure, however, exists and is remarkable. Through a Sustainable Urban Logistics Plan a proposal for exploitation is imposed.

3.2 Existing Logistics Services

Distribution of goods within the city, is being carried out by small vans (freight taxis) which transship all products reaching from Athens, Thessaloniki and other regions of Greece in the existing warehouses of Serres. Generally, Serres' freight transport system can be divided into two categories. The delivery of products produced in local industries (eg SERGAL, KRI - KRI etc.), or the supply of super markets and the delivery concerning small local stores.

The first one is being carried out by big trucks that start early in the morning and have completed all deliveries until 9:00 a.m. when the morning peak hour is observed.

The second includes all products reaching the city of Serres from Athens and Thessaloniki between 9:00 and 11:00 a.m, reload at freight-taxis and finally arrive in local stores from 10:00 until 15:00p.m or until early in the afternoon. In total 45 freight-taxis (gross weight up to 10 tons) are used every day, according to the representative of the Association of freight-taxis in order to complete the city's distribution needs.

3.3 Questionnaire Survey Addressed to Shopkeepers

In order to identify the best measures to be undertaken within the project's context, a questionnaire survey was conducted to the shopkeepers of Ermou Street. According to the recording, the shops can be categorized as shown in Table 3.1 below.

Table 3.1: Distribution of Ermou Street stores per category

TYPE OF STORE	NUMBER/PERCENTAGE		TYPE OF STORE	NUMBER/PERCENTAGE	
Clothes	20	29%	Fast Food	7	10%
Footwear	10	45%	Jewel	7	10%
Household Items	5	7%	Cosmetics / Fragrances	2	3%
Optical Goods	3	4%	Café / Bar	2	3%
Linens-Pottery & Glass	2	3%	Travel agency	1	2%
Fruit and vegetables	1	2%	Sewing	1	2%
Headgear	3	4%	Gifts	1	2%
Nuts / Coffee	3	4%	TOTAL NUMBER	68	

The questionnaire that was used aimed at capturing the key problems in loading and unloading procedure. Shopkeepers were asked to assess the existing methods of products' distribution and the loading and unloading system of Ermou Street, to explain their daily problems and give their views on measures and actions which could contribute to upgrading the process and improving the situation. In addition, the survey explored whether shopkeepers are aware of sustainable urban mobility and sustainable urban logistics issues and whether they are willing to participate in a joint action in order not only to upgrade the road network of the city but also to improve the quality of their lives.

Out of the 68 stores located in Ermou Street, 49 completed the questionnaire. Fast Food and Coffee/Bar stores (9 in total), were not included in the sample as there are differences in their opening hours. Also 10 stores either refused to participate in the survey or heavy workload did not allow them complete the questionnaire. The questionnaire is included in Annex B of this deliverable. The analysis of the questionnaire survey is presented below. According to diagrams 3.1 and 3.2 most stores of Ermou Street are sole properties (88%) and most stores are rented (73 %)

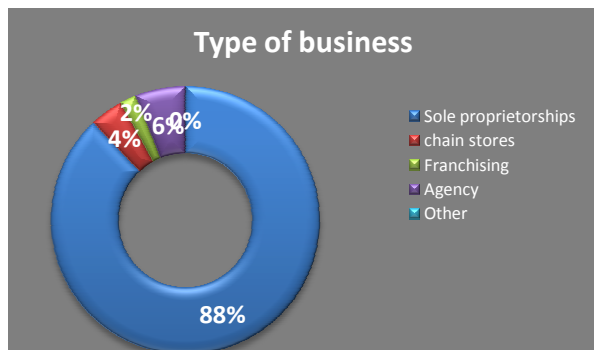


Diagram 3.1: Type of business

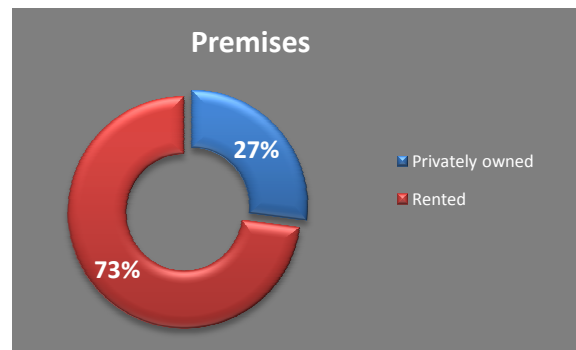


Diagram 3.2: Premises status

As regards products' distribution, as shown in the following diagrams, the busiest time-period is between 07:00 and 09:00 in the morning (37%) while also many shopkeepers state that there is no specific time of delivery of goods (31%). Regarding delivery method, most shops are served by transport companies (68%), 15% transfer goods using their own means and 'other' mainly refers to courier companies that deliver small packages and mail.

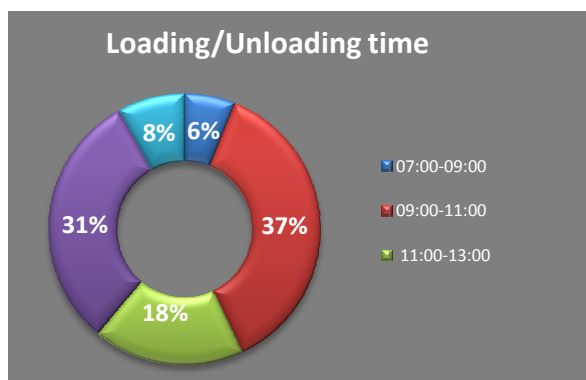


Diagram 3.3: Loading/Unloading time

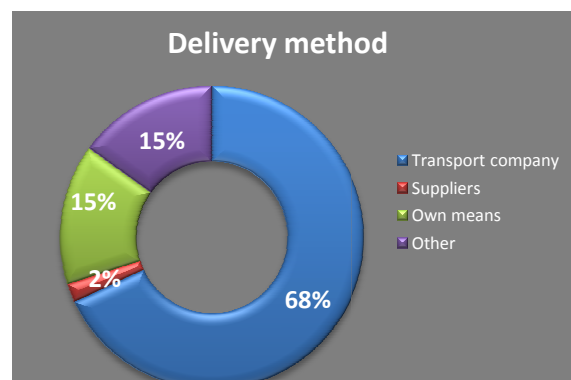


Diagram 3.4: Delivery method

75% of vehicles used are conventional closed-vans and 18% motorcycles (according to the answers in the 'other' category), while duration does not exceed 5-10 minutes, according to diagrams 3.5 and 3.6.

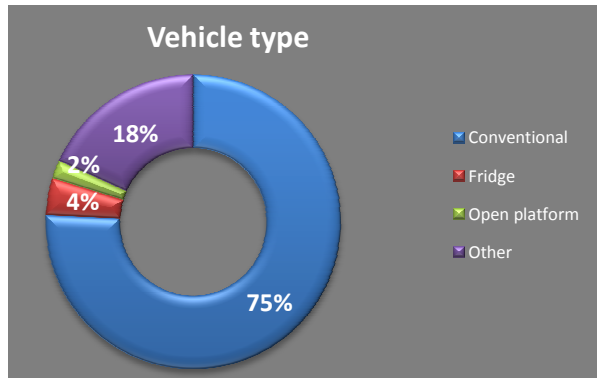


Diagram 3.5: Loading and unloading vehicle type

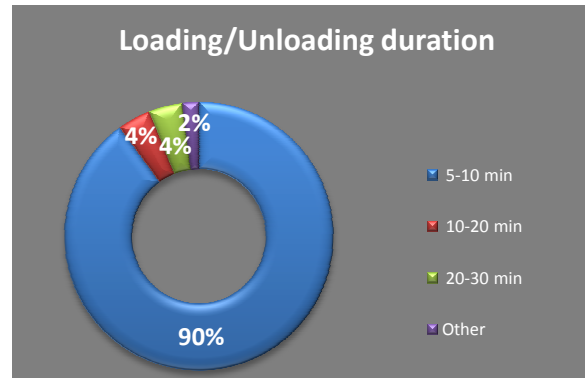


Diagram 3.6 : Loading and unloading duration

To the question "How often do you experience problems related to loading/unloading spaces being illegally occupied by other vehicles" 84% of respondents answered daily and 12% fairly often (in total 96 % of respondents identify this as an important problem). In order to support loading/unloading spaces 44% of the respondents believe that better signage would be important and 33% believe that strengthening policing would generate positive results. Finally, reducing parking cost is a factor that would better support the adequate use of loading/unloading spaces (diagrams 3.7 and 3. 8).

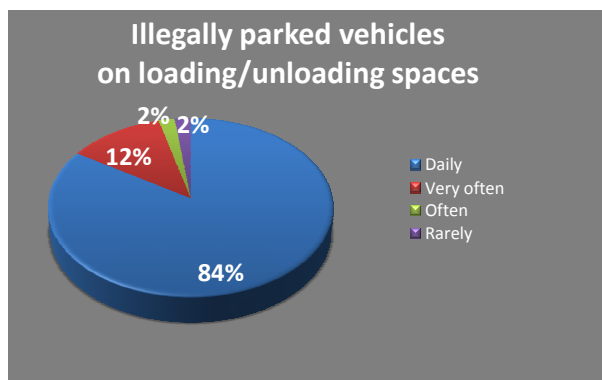


Diagram 3.7: Illegally parked vehicles on loading/unloading spaces

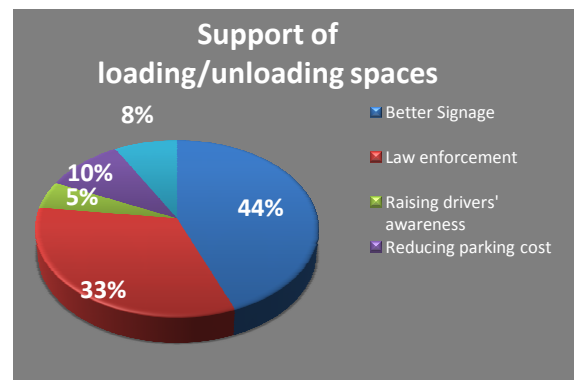


Diagram 3.8: Support of loading/unloading spaces

As to the degree of familiarity with technology, according to the answers of the respondents, 26% is very familiar, 31% is fairly familiar, 15% not that familiar and a big percentage of around 28% is not familiar at all.

To the question "Would you be interested in an online platform through which you could book loading/unloading space for specific duration" the vast majority is negative (75% is not interested at all and 10% is not that interested), whereas only 5% answered that they would

be very interested in using an e-booking system. Moreover, 43% believes that such a system would bring positive results on products' distribution while the remaining 57% is totally negative.

As for respondents' preferred transport mode, (Diagram 3.9 and 3.10), 47% prefer walking, 36% uses private cars as driver and 13% motorbikes. The remaining 4% prefers other modes of transport (bicycle, private vehicle as passenger). Out of the 64% of respondents travelling by car, motorbike or bicycle, 92% say that the main problem they face is finding a parking space (92%).

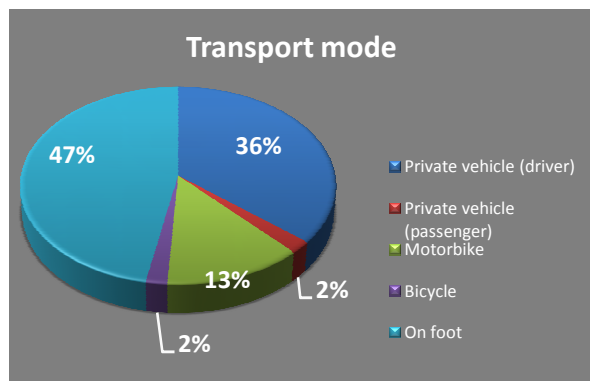


Diagram 3.9: **Transport mode**

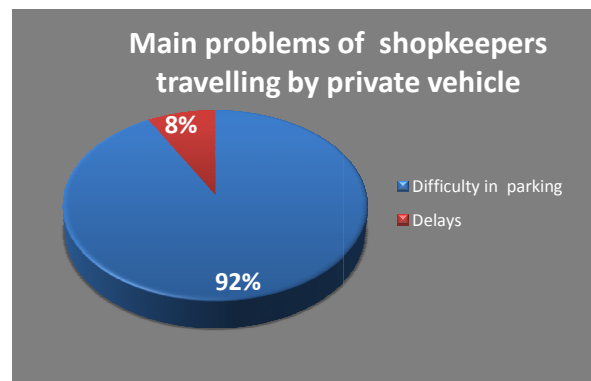


Diagram 3.100: **Main problems of shopkeepers travelling by private vehicle**

To the question "Where do you park your car" (Diagram 3.11), 49% answered in 'legally on nearby streets' and 26% 'legally on Ermou street', while nobody uses the parking stations. And the main reason for this is, according to 85% of the respondents, is the very expensive price (Diagram 3.12).

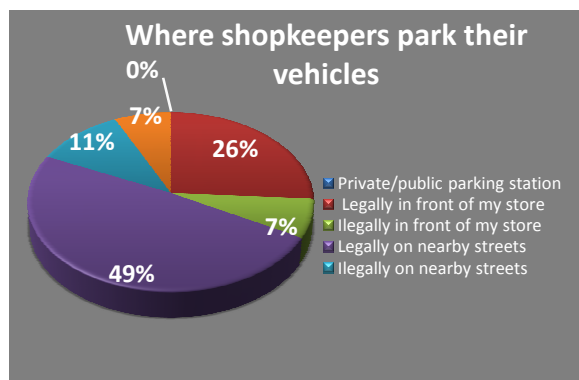


Diagram 3.111: **Where shopkeepers park their vehicles**

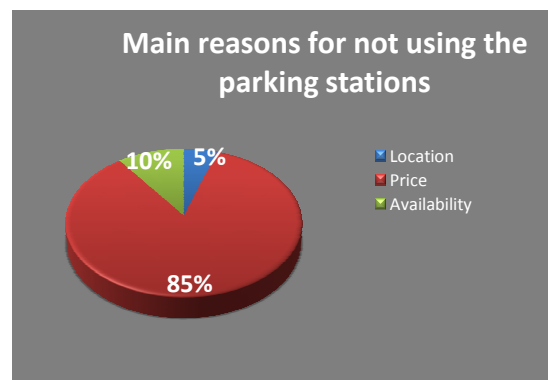


Diagram 3.112: **Main reasons for not using the parking stations**

Nevertheless, to the question "Would you be interested in parking in a private / public parking station with favourable payment terms" 54% is positive while the remaining 46% answered negatively. To the question "what amount would you be willing to pay for parking in a parking station" the few respondents reported an amount ranging from 20 to 30 € per month.

The overall conclusions of the questionnaire survey is that shopkeepers do not believe that there is lack of loading/unloading spaces and do not consider the creation and use of an e-booking system necessary while they suggest strict policing of existing spaces. Last, was highlighted the need to inform road users about loading/unloading parking spaces operation and regulations.

3.4 Questionnaire Survey Addressed to the Association of Transporters (freight-taxis owners) in Serres

The recording of transporters' needs and opinions, distributing products to local stores within the city centre, showed the basic problems that they daily face. It also revealed in what way the existing infrastructure and institutions in force affect sustainable urban mobility. In total five main transporters were interviewed and answered the questions depicted in the table below.

Table 3.2: Distribution of Ermou Street stores per category

Transporter	1	2	3	4	5
Fleet (number of vehicles)	2	1	1	3	3
Vehicle type	Mercedes 208,307	Mercedes, 1023	Ford Ranger	Volvo man	Mitsubishi cander, Veco euro cargo
Year	1981,1991	2000	2005	2004-2006	1998-2004
Engine			2500		4000
Euro category		II, III, IV		0	III
Covered distance (km) from warehouses to the main loading/unloading places of the city centre	7	11	18	5	30
Total distance (km) covered as transporters can't find the loading/unloading places free to park	14	13,75	22	7	33
Total distance (km) covered daily in Ermou Street due to the occupation of the loading/unloading place	3	4	3	2	3

According to data collected from the main five freight transport companies, the total distance (km) covered daily from warehouses to the main loading/unloading places of the city centre ranges from 7 to 30 km (Diagram 3.13).

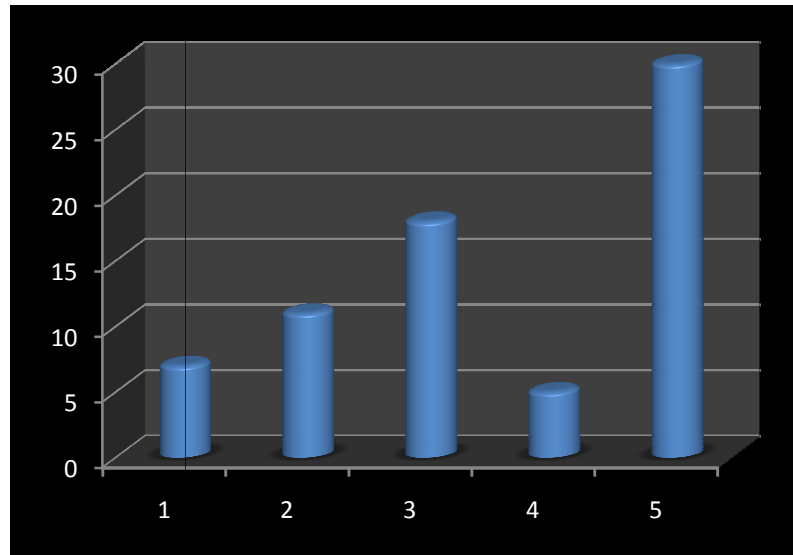


Diagram 3.13: Covered distance (km) from warehouses to the main loading/unloading places of the city centre

The number of kilometers above rises according to the transporter's estimation, due to the extra distance they have to cover as the loading/unloading places are usually illegally occupied by private cars and they are forced to drive for a long time until they find one place free to park. The extra distance (km) covered ranges from 7 to 33 km (Diagram 3.14)

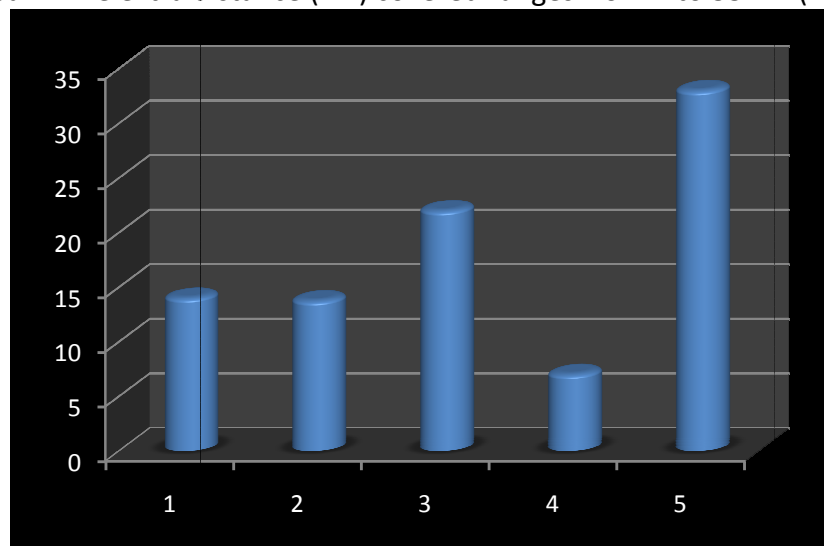


Diagram 3.14: Total distance (km) covered as transporters can't find the loading/unloading places free to park

Regarding Ermou Street, one of the most commercial streets of the city centre, transporters who daily serve the stores there, estimate that the extra distance they cover for the delivery of goods along the street, ranges from 2 to 4 km, when the overall length is 250 meters (Diagram 3.15).

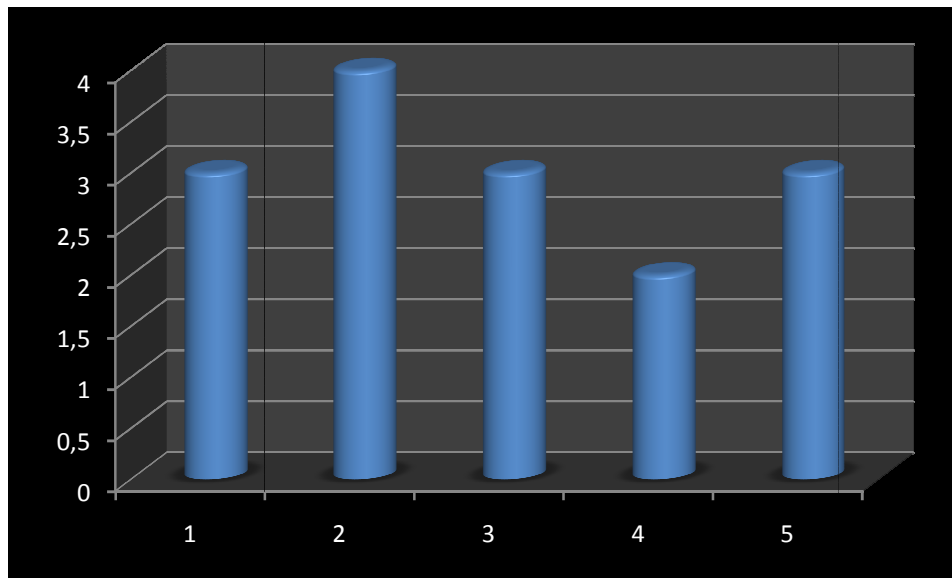


Diagram 3.15: Total distance (km) covered daily in Ermou Street due to the occupation of the loading/unloading place

3.5 Highlight Logistics Problems

The system of freight transport in the city of Serres can be divided into two categories.

Supply of stores with products produced in local industries (e.g. milk industries like SERGAL, KRI-KRI etc.) or related to large super markets and supply of small local stores.

The first kind of supplies is carried out by big trucks that start early in the morning and complete distributions before 9:00 when commercial activities and inevitably traffic begin.

The second is related to distribution of products that arrive from Athens and Thessaloniki between 9:00 and 11:00 in the morning, get reloaded to small vans (freight taxis) and then get delivered to stores from 10:00 till 15:00 and often during the afternoon as well. This supply category, burdens with 45-50 freight vans the city network furthermore and calls for dedicated parking spaces to avoid problems in road capacity due to double parking for loading and unloading activities or unnecessary circulation of freight vehicles until they find a parking space.

Today in the city of Serres and for freight vehicles' convenience, approximately 30 loading/unloading places are in operation. Due to the continuous change of land uses and the urban reform that is taking place in the city, many of these spaces have been abolished or are not valid anymore.

Moreover there is no policing reinforcement. One of the most important problems carriers face in the city centre is the illegal parking of cars on loading and unloading spaces. The parking characteristics survey along Ermou Street confirmed the statement that had been made to the project team by the president of the association of freight taxi owners of Serres, in a meeting that took place in Serres on 1/11/2013.

Additionally, apart from policing, additional effort needs to be made to exclude private cars' access by using special protective equipment (stakes, bars, etc.).

Finally, drivers' behaviour, illegally parking in the loading and unloading spaces, highlight the lack of public's information on the importance of the proper operation of these spaces without restrictions, the need to raise awareness on sustainable mobility issues and to realize the problems they pose with their illegal behaviour.

4 BEST PRACTICES AND SOFT MEASURES BENCHMARKING TO PROMOTE SUSTAINABLE URBAN LOGISTICS IN THE CITY OF SERRES

4.1 Urban Freight Transport Best Practices

Urban freight transport affects the operation of the urban environment both economically, socially and environmentally.

The economic impacts refer to congested roads and waste of resources, the social ones to the implications of pollutants to public health, accidents' increase, visual pollution, urban green and open space shrinkage and finally environmental emissions and waste increase etc.

To mitigate all these negative effects as well as to improve freight transport in cities, several measures and policies have been proposed and are nowadays being implemented. Measures and policies for sustainable urban freight transport are described below in order to conclude to the measures that could directly and efficiently be applied in a specific axis of Serres and then get evaluated for their effectiveness.

4.1.1 Users' awareness raising and information on sustainable urban freight transport

The effect of city logistics on the way a city operates is not particularly known to citizens. For this reason various awareness and information raising activities are required including:

- Distribution of dissemination material informing citizens about environmentally friendly transportation in the city, leading to decongestion of roads and the upgrade of environmental conditions and citizens' quality of life.
- Distribution of dissemination material to shops and citizens informing them about loading and unloading places, permitted hours and any other restrictions (such as maximum load allowed etc)
- Training seminars on sustainable urban freight transport focused on citizens, transport companies and shopkeepers
- Incentives to transporters and shopkeepers who suggest and implement practices that support sustainable urban freight transport
- Organization of workshops addressed to all stakeholders for exchange of views, problem solving and proposals that may lead to more efficient city logistics



Figure 3.1: Dissemination material from a campaign [7]

4.1.2 Spatial and temporal restrictions

Measures of spatial and temporal restrictions include restrictions relating to time constraints (e.g. freight transport permitted hours, specific routes, night routes etc.) or specific locations, regions or areas where loading and unloading takes place. These restrictions are being adopted by the authorities mainly for safety and environmental protection reasons and apply to sensitive to traffic areas (mainly in the city centers).

Urban authorities may define loading and unloading places in areas that attract or generate traffic but do not have adequate infrastructure. These places may be available with or without time constraints and their design may fit one or more vehicles depending on the size of vehicles that are allowed to use them.

It is important to note that for the successful use of the places, signage should be clear and distinct. This requires use of modern signage methods and correct and adequate of information transmission.



Source:[8]

Figure 3.2: Loading and unloading signs

Stocholm

In the capital of Sweden, the following regulations are in force:

- Commercial vehicles weighing more than 3.5 tonnes are not allowed to circulate around the city during the night (20:00 to 6:00)
- Freight vehicles, longer than 12 meters, are not allowed to enter the city center.
- Heavy vehicles' age must be less than 8 years [7]

Hertogenbosch

In Hertogenbosch city, in the Netherlands, specific regulations regulating freight vehicles' access in the city center after 12:00 noon have been introduced.

Access permission is only given to carriers:

- (a) whose fleet consists of environmentally friendly vehicles and that have their own logistics centre. Every vehicle should have scheduled deliveries in at least 60 regions and 20 delivery points per route.
- (b) who use quiet trucks, reducing the number of routes. [9]

Aalborg

In Aalborg, loading and unloading zones have been established in narrow pedestrian streets and each zone serves many vehicles, allowing the passage of other trucks, reducing congestion during morning distribution hours. Local shops have also agreed to place on the road signs and their goods only after 11:00 [8]



Source: [8]

Figure 3.3: Loading and unloading zone in Aalborg

4.1.3 Urban logistics centres

Bordeaux

The city of Bordeaux faces intense commercial activity and the distribution of goods in the city center is prohibited from 10 am onwards as at that time the congestion problems are particularly severe. Moreover, the construction of a tramline since 2000 is an additional burden on the roads.

In 2003, in an effort to improve this situation, special parking areas for loading and unloading have been created (Espace de livraison de proximité - ELP). This approach also included the installation of a transshipment platform where trained staff provides assistance in urban distributions.



Source: [8]

Figure 3.4: Local area delivery in Bordeaux (Espace de livraison de proximité – ELP)

Goods are transhipped from trucks to carts, electric vehicles and bikes (tricycles) for the last part of the delivery. For deliveries carried out by bicycles packages are not allowed to be heavier than 30 kilos, while heavy goods are transported by electric vehicles. [10]



Source: [10]

Figure 3.5: Freight bicycles

ELP is located in an area with plenty of space and is only addressed to trucks that load/unload goods for the nearby shops. The facility serves 3 to 5 trucks at a time and operates Monday to Friday from 09.00 to 17.00 and Saturday from 09.00 to 11.00.

The first results after its operation show that the ELP system is popular to transport companies because it guarantees a safe unloading area near the commercial areas of the city center. In addition the environmental benefits are also important as it has been

estimated that the replacement of a truck with a tricycle leads to 6 tons per year CO₂ emissions reduction and noise levels decrease. [8]

Lucca

The Municipality of Lucca decided to construct a warehouse and logistics center using electric vehicles that is functional since 2005 (Lucca Port). Goods are either stored in a special area or transhipped from trucks to electric vehicles that are allowed to access the historic city center of the city for the last mile delivery. Moreover, services that enable collaboration among stakeholders (carriers, shopkeepers) and organization of freight transport are also provided.

The four electric vehicles that are being used have resulted in 12% CO₂ emissions and 15.4% energy consumption reduction. [9]



Source:[9]

Figure 3.6: Urban logistics centre in the city of Lucca, Italy

4.1.4 New technology vehicles

Rouen

In Rouen, tricycles are used for the last mile delivery of urban freight transport. [7]



Figure 3.7: Last mile delivery bicycles

Hertogenbosch

To stimulate the implementation of sustainable solutions for urban freight transport, the Municipality of Hertogenbosch, in the Netherlands has adopted measures relating to:

- The creation of an environmental zone area in the city center where only 'clean vehicles' (electric or diesel/gas powered vehicles) are allowed to enter
- The development of a specific service that aims to serve the delivery of bulky and heavy cargo using small buses that are operating in the city. [9]

Trondheim

In Trondheim, Norway, electric vehicles of various capacity, length and speed are used for urban deliveries, depending on the load that needs to be distributed (Figure 4.7)



Source:[9]

Figure 3.8: Environmentally friendly vehicles used for urban freight transport

Padova

As part of a program in Italy, 7 methane powered trucks, deliver goods in the city center on behalf of all transport companies, except courier companies. The trucks begin the deliveries from a 1000 sq.m area near the port and deliveries are made all day long using specific lanes and dedicated unloading places. [7]

Stockholm

Since 1996, a program in Stockholm promotes the identification of environmental zones in the city center. In these zones and according to the regulations, only vehicles of a specific "environmentally friendly category" and diesel vehicles over 3.5 tones are allowed to enter [7].

4.1.5 ICT E-platforms and collaboration between stakeholders in urban freight transport

Siena

In the framework of eDRUL project, an online platform to better manage urban freight transport has been developed. The following scenarios have been included:

1. B2B Services (Business to Business) for the distribution of goods in the restricted traffic area through special permissions.

Access to the restricted traffic area is only allowed to commercial vehicles that are authorized (vehicles that meet certain standards) and to licensed urban fleet 'commercial taxis', or to vehicles that do not pollute the environment

2. "Park and Buy" Service (B2C)

Citizens purchasing items or goods from an area that is not accessible to cars, can receive them from a certain car parking location of the city.

3. B2B services for the distribution of goods with the **collaboration among transport services providers** and the use of a logistics centre.

This scenario serves the following logistics functions:

- Cooperation between long-distance carriers and companies that distribute goods, solving last mile problem
- Cooperation between long-distance carriers for freight in order to cope with access restrictions.
- Cooperation between long-distance carriers and companies that distribute goods for returned goods management [7]

4.1.6 Real-time routes' optimization

There are several supporting technologies available such as ITS vehicle telematics (in-vehicle units), GPS, smart cards and message screens connected with traffic or transportation management systems.

These systems are used to improve routes and travel planning as well as the services provided to customers (e.g. estimated time of arrival).

Freight transportation management systems offer:

- Automatic route calculation with optimal vehicle load and number of trips for carriers.
- Navigation and information on vehicle location, traffic and changes in customers' requirements.
- Driver and company or customer communication
- Internet booking system by coordinating and planning arrivals of trucks in central areas with heavy traffic [8]

4.1.7 Night routes

PIEK project in the Netherlands

Deliveries in stores are usually made in the afternoon, early in the morning or during the night. Many people in Dutch cities reside near or over stores, and as a result they are exposed to noise due to delivery activities. According to the law about noise pollution, the noise produced by freight transport must comply with strict standards.

A study showed that many loading and unloading activities exceed the limits of 60 and 65 dB (A) that have been proposed for the afternoon and night.

For this reason, the Dutch government cooperated with the PIEK project to help the market develop techniques and purchase equipment to meet the noise standards.

PIEK project includes the following activities:

- (i) transfer of knowledge to urban freight transport companies
- (ii) encouragement of noiseless activities
- (iii) adequate loading/unloading places
- (iv) quiet delivery vehicles up to 7.5 tones
- (v) quiet delivery vehicles over 7.5 tones
- (vi) quiet coolers facilities
- (vii) quietly forklifts,
- (viii) reduction of containers, pallets and other noise (ix)
- (ix) reduction of shopping trolleys in stores noise
- (x) electric or hybrid electric and diesel or gas powered vehicles [8]

4.2 Candidate Measures/Services Identification and Selection

All the measures/practices mentioned above aim at supporting sustainable urban freight transport and could potentially find application in the city of Serres. However, for this study a SWOT analysis follows separately for each measure including major strengths, major weaknesses, key opportunities and threats, while in the Sustainable Urban Logistics Plan (SULP) deliverable a multi-objective analysis will be conducted. The SWOT analysis will result to the measures that are directly applicable at the least cost.

The measures are:

- Users' awareness raising and information on sustainable urban freight transport
- Spatial and temporal restrictions
- Urban logistics centres
- New technology vehicles
- ICT E-platforms and collaboration between stakeholders in urban freight transport
- Real-time routes' optimization
- Night routes

Measure 1: Users' awareness raising and information on sustainable urban freight transport	
Strengths • Directly applicable • Low cost • Involvement of both stakeholders and citizens in policy issues on urban freight transport	Weaknesses • The results are not direct • It takes time to gather citizens' feedback
Opportunities • Behavior change of stakeholders and citizens • Existing initiatives that support urban freight transport • Understanding benefits from the creation of collaborative schemes • Sustainable Urban Mobility awareness exploitation • Modal shift to alternative modes of transport (bus, bicycles, on foot) • Loading/unloading places will serve only the distribution procedure	Threats • Unsatisfactory participation and audience's response • Short duration of the action

Measure 2: Spatial and temporal restrictions	
Strengths • Soft measure, easily applicable • Reduction of environmental impact • Effective management of roadside parking • Congestion reduction • Accidents prevention	Weaknesses • Compliance with regulations • Bureaucracy • Possible damage of signage equipment
Opportunities • Use of the awareness raising campaigns for informing the public about spatial restrictions • Environmental upgrade of the area • Acceptance and implementation of	Threats • Possible violation of the measure

additional measures and practices for promoting sustainable urban mobility • Acceptance and implementation of additional measures and practices to facilitate urban freight transport • Effective use of road infrastructure in the city center • Proper management of Loading/unloading places • Reduction of total distance covered by transporters • Reduction of traffic congestion • Reduction in CO2 emissions • Energy savings	
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Measure 3: Urban logistics centers	
Strengths • Exclusion of large vehicles • Economies of scale • Safe unloading areas • Use of alternative (environmentally friendly) means of transport	Weaknesses • High investment costs • High operating costs • Difficulty in developing collaborative schemes • Potential inefficiency • No direct contact between customers and carriers • Possible increase in freight transport costs
Opportunities • New jobs • Environmental upgrade of the area • Possibility to use low impact vehicles for last mile deliveries	Threats • The recession in the supply chain industry

Measure 4: New technology vehicles	
Strengths • Emissions reduction • Reduction of vehicles' operating costs • Reduction of transportation costs • Benefits in transport companies' profile	Weaknesses • High cost of purchase • High operating costs • Low efficiency of electric vehicles (frequent recharges, limited range) • Limited market availability
Opportunities • Need for new technologies vehicles use • Tax cuts and benefits for the use of new technologies vehicle • Funding and support measures • A combination of incentives and constraints	Threats • Inadequate infrastructure (eg charging stations)
Measure 5: ICT E-platforms and collaboration between stakeholders in urban freight transport	
Strengths • Better of urban freight transportation management • Synchronization of transport operators in loading and unloading areas and better service • Improvement of reliability • Coordination and planning of arrivals of trucks in heavy traffic areas • Congestion reduction	Weaknesses • Flexibility for simultaneous customer service • Reduced use in case the use of the platform is free of charge • Familiarity with information technologies and an internet connection is a prerequisite
Opportunities • Exploitation of increasing carriers and customers familiarity with new technologies • Better exploitation of loading/unloading places • Better organization for shopkeepers	Threats • Limited level of carriers organization • Technical system problems • Requirement for cooperation of stakeholders • Users non-acceptance of the system

and transporters • Better planning and coordination of trucks' arrivals in the center of the city • Reduction of traffic flows • Reduction of noise and air pollution	
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Measure 6: Routes' optimization	
Strengths • Improvement of reliability • Support to truck drivers and vehicle kilometers reduction • Travel time reduction • Congestion reduction	Weaknesses • Significant cost for information provision (real-time road traffic conditions, volumes, speed etc)
Opportunities • Promotion of sustainable urban mobility • Improvement of time and service reliability • Reduction of operating costs for transporters • Reduction of traffic flows	Threats • Reduced use in case the use of the platform is free of charge • Familiarity with information technologies is a prerequisite

Measure 7: Night routes	
Strengths • Improvement of reliability (travel-time reduction) • Emissions reduction • Accidents' reduction • Congestion reduction • Fuel consumption reduction	Weaknesses • Noise pollution • Security problems (eg for transport of high value goods) • Additional staff to receive goods when the shops are closed • Personnel costs increase in order to work during night hours
Opportunities	Threats

• New jobs • Reduction of traffic flows during the day • Possibility to use low impact vehicles in order to reduce noise	• Low level of citizens' acceptance
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Based on the characteristics of Serres study area and according to the SWOT analysis conducted above, all candidate measures examined could be implemented in the city of Serres in order to enhance sustainable urban mobility. Some of them are directly applicable and could be implemented quickly and at a relatively low cost (Measures 1, 2, 5, 6) while others are quite costly or require more time for planning, implementation and final application (Measures 3, 4, 7).

From the seven in total candidate measures a selection of the most suitable ones was made, including two short-term measures (1,2) two medium-term (5,6) and one long-term (3). The selected measures are described and further analyzed below.

4.3 Short Term Measures

4.3.1 Users' Awareness Raising and Information

Requirements for the implementation of the measure

The measure of users' awareness raising, aims at reaching interest of all stakeholders in order to foster further behavioural patterns of responsible citizens. More specifically, the aim of this measure is to inform citizens about the way urban freight transport affect both their daily life and the urban environment, in order to understand that the infrastructure available for exclusive use by the fleet of trucks delivering goods within the city (loading/unloading places), should not be violated by private cars. Of course, freight transport as part of the general traffic situation of an urban area affects and is affected by it. The reinforcement of sustainable mobility and the respect of rules governing traffic and parking in a road network, can bring great improvement concerning urban freight transport system efficiency. Information and awareness of citizens therefore on the above issues, can be achieved through various actions relating to the preparation and production of leaflets, events open to the public (open days), organized workshops with stakeholder involvement, etc. Regarding the requirements that should be met by the implementation of the selected soft measure, those are discussed below:

Infrastructure requirements

The measure does not require the construction of new infrastructure as it is an easily applicable measure.

Regulations and legal framework

The distribution of leaflets and the organization of events open to the public should always follow the relevant legislation. Specific legal framework on transparency should be followed

in the case of establishing reward policies to transporters and shopkeepers who implement practices to support sustainable urban freight transport. This concerns lottery procedures, benchmarking etc.

Required technological equipment

Technology equipment is not required to implement this measure. However, the use of computer applications or services are common tools for informing the public, such as the use of special web pages, e-learning, promotion through information platforms etc. For this case the use of related equipment is required such as the EASYTRIP electronic services platform available by the Municipality of Serres, Municipality's webpage, relevant announcements to existing VMS, etc.

Key factors involved in the measure's implementation

The main key actor involved in the measure's implementation is the Municipality of Serres, who will be responsible for the design and the implementation of information campaigns and the uploading of the related content to the Municipality's website and the EASYTRIP platform. The Municipality of Serres could also cooperate with actors that can influence and can be influenced by an upgraded freight transport system in the city such as the Association of Transport companies, the Commercial Association and the Chamber of Commerce of the city.

Organisational and managerial context

Municipality of Serres will have the central organization of the measure and will cooperate with the Commercial Association and the Chamber of Commerce of the city in order to design and use the appropriate material for an optimal result.

Basic financial requirements for the implementation of the measure

The financial requirements of the measure are related to the cost of graphic design, the printing of material that will be distributed at various events (e.g. open days), the organization of the 2nd ARE. These costs will be covered by ENCLOSE funding. However, on the occasion of specific events, if additional material is to be produced, relevant professionals or their Associations who will benefit directly from the final results of this measure, could also sponsor related expenses.

Announcements posted on the Municipality's website and the platform of EASYTRIP project, where Serres took part, do not require extra cost.

For the best possible result, all the above actions should be repeated at regular intervals, while evaluation of their impact on the general public should be assessed. The results of the evaluation will then be used for discussion and decision -making in meetings where all stakeholders will be involved. The evaluation process should follow specific indicators and should use specific type of questionnaires for the survey. In case that the evaluation process is designed and carried out by the Municipality of Serres it could have no cost if all the mentioned electronic instruments will be used (Website, EASYTRIP Platform).

The efficiency of the measure depends on the planning and organization of events and workshops, but also on the synergy of all stakeholders to update periodically all data included to the dissemination material.

The results expected from the implementation of the measure, are directly related with the citizens' attitude change. Information and awareness on issues related to Sustainable Urban Mobility and Sustainable Urban Freight Transportation is an issue that requires both effort and time.

The Table below depicts the cost estimation of the measure.

	SHORT DESCRIPTION	QUANTITY	PRICE PER UNIT	COST
1	Large Brochure (50x70)	10	6.5	65
2	Small brochure (A3)	20	0.75	15
3	Banner (0.8x2 m)	2	50	100
4	4-page leaflet of the Enclose project (A5)	250	0.32	80
5	Informative leaflet of the Enclose project (A4)	250	0.32	80
6	Informative leaflet of the campaign	400	0.5	200
		Net value		540
		VAT		124.20
		Total Cost		664.20

4.3.2 Spatial and temporal restrictions

The measure aims to establish temporal and spatial restrictions in order to increase effective use of road infrastructure, to reduce traffic congestion in the city centre, to protect the environment and finally to increase safety for commuters.

Infrastructure requirements

The infrastructure required is either constructed or under construction loading/unloading places equipped with the appropriate signage (horizontal stripping, vertical signs etc). The signage should be sufficient, clear, in excellent condition and should communicate all the necessary information for parking and loading regulations.

Regulations and legal framework

Both temporal and spatial restrictions (which places are considered as loading/unloading places, operating hours, etc) should follow all the relevant Regulatory Decisions of the Municipality. These decisions will be taken considering the actual needs both in terms of number of seats that should be constructed in each axis and in the processing time for the loading/ unloading procedure.

Required technological equipment

No special technical equipment is required for the implementation of this measure. However, it should be noted that the spatial segregation could use advanced technological applications with bars that go up and down or columns getting up and sink or even with special sensors that record the occupation of loading/unloading places by freight vans. These technical solutions of course, should be considered within an overall investment plan of the Municipality in controlled parking systems due to the high cost.

Key factors involved in the measure's implementation

Only the City Council and the Technical Services of the Municipality have the jurisdiction for the operation of the specific loading/unloading places and the operating hours. For the optimization of spatial and temporal constraints a synergy between the Commercial Association of Serres is required.

Organisational and managerial context

The organization of the measure will be held by the civil authorities in close cooperation with transporters and shopkeepers of the city while the management will be carried out by the Municipality of Serres.

Basic financial requirements for the implementation of the measure

The financial requirements of the measure relate to the supply and installation of sign and information plates (e.g. weight and size regulations, time duration etc.), the paint striping and special constructions for the determination of each place.

The viability of the measure depends on the compliance with the spatial and temporal constraints as well as with policing reinforcement in the loading/unloading places. According to the expected results regulations compliance will reduce illegal parking and traffic congestion, will facilitate access to loading/unloading places and finally will facilitate the whole freight distribution procedure.

The Table below depicts the cost estimation of the measure

	SHORT DESCRIPTION	QUANTITY	PRICE / UNIT	COST
1	Vertical sign of the project	28	22	616
2	Support frame for signs	28	33	924
3	Regulator Plate (small size)	15	25	375
4	Support post for signs	15	22	330
5	Horizontal striping	10	30	300
Net value				2.545 €
VAT				585.35
Total Cost				3130.35

Energy and environmental impacts

According the transporters' answers (Table below) the extra km covered daily as they can't find the loading/unloading places free to park are in total 19km and the overall yearly distance (for 300 work days per year) is $19 \times 300 \text{ days} = 5.700 \text{ km}$.

The short term measures analyzed above are expected to bring positive effects concerning the loading/unloading places' functionality, as illegally parking phenomena are expected to be reduced. Therefore, transporters will not be forced to cover extra distances until they can park their vans in the significant places, as most of the time those places will be free.

Transporter	1	2	3	4	5
Fleet (number of vehicles)	2	1	1	3	3
Vehicle type	Mercedes 208 307	Mercedes 1023	Ford Ranger	Volvo man	1 Mitsubishi cander, 2 Iveco euro cargo
Year	1981, 1991	2000	2005	1998-2004	
Engine			2500		4000
Euro category		II, III, IV		V	III
Covered distance (km) from warehouses to the main loading/unloading places of the city centre	7	11	18	5	30 (10 Mitsubishi + 10x2 Iveco)
Extra distance (km) covered as transporters can't find the loading/unloading places free to park	7	3	4	2	3 (1 Mitsubishi + 1x2 Iveco)
Total distance (km) covered daily in Ermou Street due to the occupation of the loading/unloading place	3	4	3	2	3

In order to estimate the reduction of CO₂ emissions expected from the reduction of the total distance covered from transporters, the below assumptions were taken into account, based on data provided by the transporters.

Transporter's vans are categorized depending on vehicle type. Thus 3 vans (Mercedes 208, 307 and Ford ranger) are vans <3,5 ton, 5 vans (Mercedes 1023, 3 Volvo Man and 1 Mitsubishi cander) are vans between 7,5ton-12,5 ton and 2 vans (Iveco euro) are vans <7,5 ton.

Regarding CO₂ emissions, for diesel vans <3,5 ton and for an average speed of around 30km / h (distance km covered both in urban and interurban area) these are calculated based on

the software COPERT (252gr/Km/vehicle) while for vans 7,5ton-12,5 ton the relevant number of CO₂ is (510 gr/Km/vehicle) and for vans <7,5 ton (330 gr/Km/vehicle).

Calculations are further analyzed below:

3 vans <3.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$$25\text{km} \times 252 \text{ gr/Km/vehicle} = 0.0063 \text{ ton/day}$$

$$0.0063 \times 300 \text{ days} = 1.89 \text{ ton/year}$$

Extra km covered from transporters as they can't find a free loading/unloading place to park:

$$11\text{km} \times 252 \text{ gr/Km/vehicle} = 0.0028 \text{ ton/day}$$

$$0.0028 \times 300 \text{ days} = 0.83 \text{ ton/ year}$$

5 vans <7.5 – 12.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$$26\text{km} \times 510 \text{ gr/Km/vehicle} = 0.013 \text{ ton/day}$$

$$0.013 \times 300 \text{ days} = 3.98 \text{ ton/year}$$

Extra km covered from transporters as they can't find a free loading/unloading place to park:

$$6\text{km} \times 510\text{gr/Km/vehicle} = 0.0030 \text{ ton/day}$$

$$0.0036 \times 300 \text{ days} = 0.918 \text{ ton/ year}$$

2 vans <7.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$$20\text{km} \times 330 \text{ gr/Km/vehicle} = 0.0066 \text{ ton/day}$$

$$0.0066 \times 300 \text{ days} = 1.98 \text{ ton/year}$$

Extra km covered from transporters as they can't find a free loading/unloading place to park:

$$2\text{km} \times 330\text{gr/Km/vehicle} = 0.00066 \text{ ton/day}$$

$$0.00066 \times 300 \text{ days} = 0.198 \text{ ton/ year}$$

CO₂ emissions produced yearly from the total covered distance:

$$1.89+3.98+1.98 = \mathbf{7.85 \text{ ton /year}}$$

Extra CO₂ emissions produced yearly from the extra covered distance:

$$0.83+0.918+0.198 = \mathbf{1.95 \text{ ton /year}}$$

The CO₂ emissions reduction is estimated to 20%

Energy savings

Considering that a 3.5 ton light van normally consumes 16 lit/100km we can calculate the number of lit the three vans consume yearly and the energy consumption.

3 vans <3.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$$25\text{km} \times 0.16 \text{ lit/Km/vehicle} = 4 \text{ lit/day}$$

$$4 \times 300 \text{ days} = 1200 \text{ lit/year}$$

The calorific power / lit for an average type of fuel (petrol and diesel) is equal to 35MJ/lit.

Yearly energy consumption from the total km covered from warehouses to the city centre:
 $1200 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{42000 \text{ MJ/lit}}$

Extra km covered from transporters as they can't find a free loading/unloading place to park:
 $11\text{km} \times 0.16 \text{ lit/Km/vehicle} = 1.76 \text{ lit/day}$

$$1.76 \times 300 \text{ days} = 528 \text{ lit/year}$$

Yearly energy consumption for the extra km covered as transporters can't find the loading/unloading places free: $528 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{18480 \text{ MJ/lit}}$

Considering that a 7.5 -12.5 ton van normally consumes 30 lit/100km we can calculate the number of lit the five vans consume yearly and the energy consumption.

5 vans <7.5 – 12.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$$26\text{km} \times 0.3 \text{ lit/Km/vehicle} = 7.8 \text{ lit/day}$$

$$7.8 \times 300 \text{ days} = 2340 \text{ lit/year}$$

The calorific power / lit for an average type of fuel (petrol and diesel) is equal to 35MJ/lit.

Yearly energy consumption from the total km covered from warehouses to the city centre:
 $2340 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{81900 \text{ MJ/lit}}$

Extra km covered from transporters as they can't find a free loading/unloading place to park:
 $6\text{km} \times 0.3 \text{ lit/Km/vehicle} = 1.8 \text{ lit/day}$
 $1.8 \times 300 \text{ days} = 540 \text{ lit/year}$

Yearly energy consumption for the extra km covered as transporters can't find the loading/unloading places free: $540 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{18900 \text{ MJ/lit}}$

Considering that a 7.5ton van normally consumes 25 lit/100km we can calculate the number of lit the two vans consume yearly and the energy consumption

2 vans <7.5 ton:

Covered distance (km) from warehouses to the main loading/unloading places of the city centre:

$20\text{km} \times 0.25 \text{ lit/Km/vehicle} = 5 \text{ lit/day}$

$5 \times 300 \text{ days} = 1500 \text{ lit/year}$

The calorific power / lit for an average type of fuel (petrol and diesel) is equal to 35MJ/lit.

Yearly energy consumption from the total km covered from warehouses to the city centre:

$1500 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{52500\text{MJ/lit}}$

Extra km covered from transporters as they can't find a free loading/unloading place to park:

$2\text{km} \times 0.25 \text{ lit/Km/vehicle} = 0.5 \text{ lit/day}$

$0.5 \times 300 \text{ days} = 150 \text{ lit/year}$

Yearly energy consumption for the extra km covered as transporters can't find the loading/unloading places free: $150 \text{ lit} \times 35 \text{ MJ/lit} = \mathbf{5250\text{MJ/lit}}$

Yearly energy consumption (total covered distance):

$42000 + 81900 + 52500 = \mathbf{176400 \text{ MJ/lit}}$

Extra yearly energy consumption:

$18480 + 18900 + 5250 = \mathbf{42630 \text{ MJ/lit}}$

The reduction in energy consumption is estimated to 20%

4.4 Medium Term Measures

4.4.1 ICT E-platforms and collaboration between stakeholders in urban freight transport

Requirements for the implementation of the measure

The aim of this measure is to inform users about the exact location of all loading/unloading places, their capacities and the system's operating hours. Additionally, through the use of an electronic system - platform an exploitation of all loading/unloading places in the best possible way is expected to derive, as shopkeepers and transporters have the possibility to organize the freight distribution system by booking a specific loading/unloading place for a specific time. The reservation system in this case contributes to the coordination and planning of trucks' arrivals in central areas with large flows. Therefore, a significant reduce is expected to traffic congestion, noise and air environmental pollution.

Infrastructure requirements

The measure does not require the construction of new infrastructure as it is an easily applicable measure.

Regulations and legal framework

The information provided through the electronic platform should follow all the relevant Regulatory Decisions regarding the functionality of loading/unloading places (operating hours, weight and size restrictions, access hours for freight distribution etc)

Required technological equipment

Technology equipment is not required to implement this measure, as the available by the Municipality of Serres Easytrip electronic platform, can fully meet the above requirements.

Key factors involved in the measure's implementation

The key players involved in the implementation of the measure is the Municipality of Serres who will be responsible for managing the loading/unloading reservation system, and potential users of the system such as transport companies and shopkeepers.

Organisational and managerial context

Responsible for the organization and managing of the platform will be the Municipality of Serres.

Basic financial requirements for the implementation of the measure

The online platform could be used with no extra charge.

The measure's efficiency depends on the availability of stakeholders to cooperate in order to develop a new, more automated freight distribution model in the city. The participation in an online reservation system will contribute to the smooth functioning of the delivery system, as the rate of freight vehicles traveling in central axes of the city's road network will be reduced significantly.

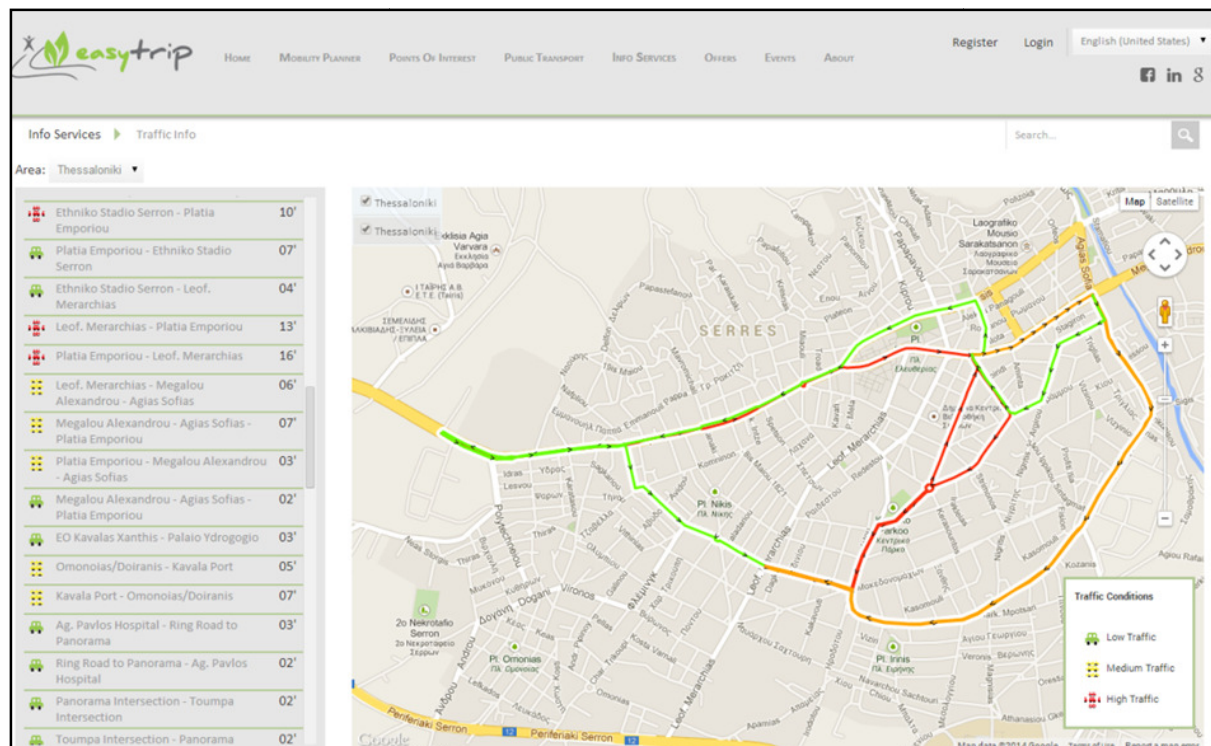
This measure can be directly applicable, as the electronic platform is already in use. However, more time for all participants is needed in order to be properly organized.

4.4.2 Routes' optimization through the provision of real time traffic system

Requirements for the implementation of the measure

The aim of this measure is to improve the time and service reliability and to reduce the operating costs of transport companies. Route optimization systems process a large number of orders, calculating the most efficient way to implement them. Therefore, all these systems estimate time and resources that will be required for the deliveries and follow specific parameters in order to ensure the system's proper functioning. Such parameters may be speed permission on various axes of the road network, the size and weight of the cargo, delivery hours in customers etc.

The Municipality of Serres can contribute to the implementation of such a measure, by providing information regarding real time travel times in specific routes of the the city centre. Information is available both through the Easytrip electronic platform (Figure 5.1) and through the VMS sign located outside the city centre. Therefore, transporters will be able to choose the route which is not congested in order to complete all deliveries.



Infrastructure requirements

The measure does not require the construction of new infrastructure.

Regulations and legal framework

The implementation of this measure should take into account all the relevant Regulatory Decisions regarding the functionality of the city's road network.

Required technological equipment

The technology equipment required concludes an electronic-system-platform which is already available by the Municipality of Serres as mentioned above (Easytrip platform) and wireless traffic counters. Today, four in total wireless traffic counters are installed in several road infrastructure segments (traffic lights, VMS sign). Those counters are connected to a server where after algorithm procedures travel times for specific routes are estimated. This information is either provided through the platform or through the VMS sign. In order the system to be expanded, the purchase and installation of four to six more traffic counters is necessary. In the future an extra VMS sign would be useful.

Key factors involved in the measure's implementation

The key players involved in the implementation of the measure is the Municipality of Serres and potential users of the system such as transport companies and shopkeepers.

Organisational and managerial context

Responsible for the organization and managing of the platform and the wireless traffic counters will be the Municipality of Serres.

Basic financial requirements for the implementation of the measure

For the implementation of the measure the estimated costs are depicted in the table below.

	SHORT DESCRIPTION	QUANTITY	PRICE / UNIT	COST
1	Development of algorithms for routing optimization	1	10.000	10.000
2	Purchase and installation of six wireless traffic counters	6	2.000	12.000
		Net value		22.000
		VAT		5.060
		Total Cost		27.060

4.5 Long Term Measures

4.5.1 Urban logistic center

Requirements for the implementation of the measure

Urban Logistics Centres (ULC) are typically “warehouses” concentrating goods that get grouped and transhipped from large trucks to small vans in order to be delivered in an area close to the centre. ULCs enable logistics companies to distribute goods to an urban area without entering the congested parts of the city. They also give the potential of improving their reliability and of using a fleet of environmentally friendly vehicles especially for areas where the use of trucks may not be allowed.

As mentioned above, among the plans of the Municipality was the establishment of a logistics centre that could be located inside a “Large Vehicles’ Parking Lot” owned by the Municipality. In this location, the Municipality aimed to create, among others, organized storage spaces by building a warehouse of about 1,000 square meters to serve carriers. In the context of these plans the company AFETIRIA SA was founded. Unfortunately, various circumstances lead to a problem performance and currently financial checks take place while even the dissolution of the company, is being considered. The infrastructure, however, exists and is remarkable.

Infrastructure requirements

Additional infrastructure is required for the construction of a warehouse of about 1,000 square meters.

Regulations and legal framework

The Urban Logistics Centre should meet all the required standards concerning operation and safety.

Required technological equipment

Initially and in case of limited activity, all the transshipment procedures will be carried out manually. However, for the facilitation of all procedures, the centre should be equipped with the appropriate technological equipment (e.g. small cranes, conveyors, forklifts, storage commodity tracking system, bar code readers, etc.).

Key factors involved in the measure’s implementation

The implementation of an urban logistics centre requires cooperation between the Municipality of Serres and the private sector (logistics operator), as well as the Association of Commerce and the Association of transporters of the city.

Organisational and managerial context

Municipality of Serres will define the restrictive regulations concerning the last part of the freight distribution process (from the urban logistics centre to the city centre). Management

will be held by private companies (e.g. AFETIRIA) in full cooperation with the Association of Transporters.

Basic financial requirements for the implementation of the measure

	SHORT DESCRIPTION	QUANTITY	PRICE / UNIT	COST
1	Construction of a warehouse (1000m ²)	1	260.000	260.000
2	Office furniture and Equipment	1	20.000	20.000
3	Freight handling equipments	1	20.000	20.000
		Net value		300.000
		VAT		69.000
		Total Cost		369.000

5 CONCLUSIONS

The main objective of the feasibility study was to define the potential application of urban logistics soft policy measures in the city of Serres. For this reason, a four step procedure was followed.

Initially a detailed analysis of the main road network characteristics of the reference area was conducted.

The analysis concluded freight traffic volumes measurements in order to gather information about how urban freight transport system affects the road network of the study area, traffic volumes measurements and parking characteristics survey in order to derive useful conclusions regarding the operation of the city's road network, the congestion that the loading /unloading procedure can create as well as the problems occur from the occupation of the relative loading/unloading places from private vehicles.

Furthermore, two questionnaire surveys were conducted to both shopkeepers of the city centre and main transporters, in order to define all needs and requirements of the region regarding the operation of the freight transport system and specific changes that should be made in order to improve its efficiency.

The procedure followed above revealed some significant problems concerning the city's road network functioning.

The freight vehicles traffic volumes measured in certain selected locations of the reference region revealed that there is a significant number of freight vehicles affecting all main axis of the city's road network. There are time periods during the day where low speeds and time delays are observed due to the distribution procedure. Therefore, noise and air pollution levels increase, degrading the area's environmental quality as well as the residents' life quality.

Traffic volume measurements showed that the higher congestion levels are observed between 8:00-9:00 in the morning, 14:00-15:00 and 18:00-19:00 in the afternoon. These time periods correspond with the city's commercial activities.

As regards the congestion flow, the Volume / Capacity ratio which determines the degree of congestion on a road section, is higher than 1 during the peak hours, leading to the conclusion that main axis of the road network are congested during these hours.

The analysis of the parking situation revealed that there is an immediate need for the enforcement of strict policy measures to both controlled parking spaces and loading/unloading spaces, as phenomena of illegally parked vehicles and of double parked vehicles (including vans and trucks) along the streets are observed all the time.

The occupation of the relative loading/unloading spaces from private vehicles burdens the city network furthermore and calls for dedicated parking spaces to avoid problems in road

capacity due to double parking for loading and unloading activities or unnecessary circulation of freight vehicles until they find a parking space.

Finally, drivers' behaviour and illegally parking in the loading and unloading spaces highlight the lack of public's information on the importance of the proper operation of these spaces without restrictions, the need to raise awareness on sustainable mobility issues and to realize the problems they pose with their illegal behaviour

All the above indicated that the freight transport system of Serres needs to be upgraded. As a second step, a number of possible policy measures which have successfully been implicated in other countries, were proposed and further analyzed.

Thus, as a third step a SWOT analysis took place in order to find the most appropriate measures that can be implemented in Serres in order to positive affect the city's logistics operation.

Finally, as a fourth step and according to the results of the SWOT analysis, five measures were ranked into short, medium and long term for implementation and were further analyzed.

The Feasibility Study for city logistics in Serres city centre showed that all the analyzed measures can provide environmental upgrade of the urban area.

This improvement will be achieved by reducing unnecessary daily distance covered by transporters due to the occupation of loading/unloading places by illegally parked private vehicles and also due to the delays related to traffic congestion and unregulated parking status of the area.

In particular, the raising of citizens' awareness so as to respect the exclusive use of loading/unloading places and the proper marking, signage and policing of these places will clear up their role in the city's road network and will lead to an overall improvement of urban life quality.

Moreover the use of advanced electronic systems such as electronic platforms providing information about the exact location of all loading/unloading places, capacities and operating hours as well as information about traffic congestion in main axes of the city's road network, estimated travel times etc, will give to shopkeepers and transporters the possibility to organize a reliable and safe freight distribution system. Therefore, a significant reduce is expected to traffic congestion, noise and air environmental pollution.

In what regards the urban logistics centre, it is important to highlight that the benefits will be remarkable in terms of environment and energy savings, but needs time and high investments costs for its implementation.

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ANNEX A

TRAFFIC VOLUMES MEASUREMENTS

POINT 1 : ERMOU - P. MELA (MORNING)																				
TURNING MOVEMENT 1							TURNING MOVEMENT 2							TURNING MOVEMENT 3						
	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses		
07:00-07:15	20		2		1		31	5	2	1	3		11	4			1			
07:15-07:30	18	1	5	2		1	36	4	3	6	4	4	9		2	1				
07:30-07:45	18	2	2	1			48	7	4	3		2	6	4			1			
07:45-08:00	38	1	4	3	1	3	47	6	6	3	3	5	12	4	1	2	1			
Hour Volume	94	4	13	6	2	4	162	22	15	13	10	11	38	12	3	4	2	0		
CPU	94	2	13	6	4	8	162	11	15	13	20	22	38	6	3	4	4	0		
08:00-08:15	48	3	5	3		1	69	22	10	8	3	4	39	8	5	6				
08:15-08:30	42	7	6	6			66	11	7	11	1	3	21	6	1	1				
08:30-08:45	52	10	4	5	1	1	77	15	6	6	4	2	31	8	4	3				
08:45-09:00	49	11	2	8	2	1	78	17	7	9	5	2	27	12	3	5				
Hour Volume	191	31	17	22	3	3	290	65	30	34	13	11	118	34	13	15	0	0		
CPU	191	15	17	22	6	6	290	32	30	34	26	22	118	17	13	15	0	0		
09:00-09:15	46	12		11	3	1	78	19	7	11	5	2	22	16	1	7				
09:15-09:30	48	7		7	2		86	30	1	8	6	2	20	9		3				
09:30-09:45	38	10	5	3		1	81	21	6	8	2	2	18	7	3	2	1			
09:45-10:00	54	13	4	4			74	19	4	9	3	3	27	12	3	3				
Hour Volume	186	42	9	25	5	2	319	89	18	36	16	9	87	44	7	15	1	0		
CPU	186	21	9	25	10	4	319	44	18	36	32	18	87	22	7	15	2	0		
10:00-10:15	42	17	2	7		1	64	18	8	7	3	2	26	8	5	3	1			
10:15-10:30	46	23		10			62	32		15	1	3	28	18	1	7				
10:30-10:45	44	19	5	8	1	1	76	20	3	6	5	2	25	18	1	2	1			
10:45-11:00	44	18	5	5	1	0.5	70	27	3	9	3	2	24	13	1	2	1			
Hour Volume	176	77	12	30	2	3	272	97	14	37	12	9	103	57	8	14	3	0		
CPU	176	38	12	30	4	6	272	48	14	37	24	18	103	28	8	14	6	0		
11:00-11:15	44	17	4	2			63	33	2	12	1	2	22	7	1	1				
11:15-11:30	52	10	7	2			57	24	5	3	1	2	22	19	4	1				
11:30-11:45	41	16	1	2	2	1	78	23	6	5	3	2	30	9		1				
11:45-12:00	43	26	4	2	3		84	15	6	8	3	2	21	29	5	3	1			
Hour Volume	180	69	16	8	5	1	282	95	19	28	8	8	95	64	10	6	1	0		
CPU	180	35	16	8	10	2	282	47	19	28	16	16	95	32	10	6	2	0		
12:00-12:15	46	20	6	4	1	1	59	30	5	8	3	2	21	20	3	4				
12:15-12:30	38	19	8	1	1		64	20	8	8		2	27	1	1	1				
12:30-12:45	48	27	5	6	1	1	70	41	6	8		3	25	27		4				
12:45-13:00	34	18	1	6		1	66	22	5	3	2	2	29	25	2	4				
Hour Volume	166	84	20	17	3	3	259	113	24	27	5	9	102	73	6	13	0	0		
CPU	166	42	20	17	6	6	259	56	24	27	10	18	102	36	6	13	0	0		
13:00-13:15	31	23	1		1		61	31	3	6	2	2	16	24	8	1				
13:15-13:30	41	14	4	3	1		57	21	4	9	3	2	24	24	3	3				
13:30-13:45	48	16	4	6		1	72	23	8	7		2	25	15	1	1				
13:45-14:00	47	16	4	7	1	1	71	30	9	5	1	2	26	19	1	2				
Hour Volume	167	69	13	16	3	2	261	105	24	27	6	8	91	82	13	7	0	0		
CPU	167	37	13	16	6	4	261	52	24	27	12	16	91	41	13	7	0	0		
TOTAL	1160	376	100	124	23	18	1845	586	144	202	70	65	634	366	60	74	7	0		
TOTAL CPU	1160	190	100	124	46	36	1845	290	144	202	140	130	634	182	60	74	14	0		

POINT 1 : ERMOU - P. MELA (AFTERNOON)																		
TURNING MOVEMENT 1							TURNING MOVEMENT 2						TURNING MOVEMENT 3					
	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses
14:00-14:15	46	15	3	7	3	1	71	37	11	2	2	3	28	23	1	3	0	0
14:15-14:30	43	25	9	4	0	0	80	16	2	6	2	2	38	16	3	2	0	0
14:30-14:45	39	13	1	4	1	0	66	22	5	5	0	2	37	14	2	2	0	0
14:45-15:00	39	19	3	1	1	0	78	21	7	4	2	3	32	22	1	2	1	0
Hour Volume	167	72	16	16	5	1	295	96	25	17	6	10	135	75	7	9	1	0
CPU	167	36	16	16	10	2	295	48	25	17	12	20	135	37	7	9	2	0
15:00-15:15	35	9	3	2	1	0	74	23	7	2	1	4	27	11	1	1	1	0
15:15-15:30	37	12	2	1	0	0	76	14	5	3	2	1	16	12	3	0	0	0
15:30-15:45	39	3	3	1	0	0	74	17	5	2	2	1	25	13	1	0	0	0
15:45-16:00	34	6	3	1	0	0	72	15	6	2	1	1	20	11	1	0	0	0
Hour Volume	145	30	11	5	1	0	296	69	23	9	6	7	88	47	6	1	1	0
CPU	145	15	11	5	2	0	296	34	23	9	12	14	88	23	6	1	2	0
16:00-16:15	29	9	3	0	0	0	70	12	6	2	0	1	14	9	1	0	0	0
16:15-16:30	39	11	2	2	0	0	61	14	2	2	1	2	17	9	0	0	0	0
16:30-16:45	30	6	1	2	1	0	63	8	2	3	0	1	13	14	0	1	0	0
16:45-17:00	40	5	1	0	1	0	84	16	2	1	0	1	18	12	1	0	0	0
Hour Volume	138	31	7	4	2	0	278	50	12	8	1	5	62	44	2	1	0	0
CPU	138	15	7	4	4	0	278	25	12	8	2	10	62	22	2	1	0	0
17:00-17:15	37	7	3	1	0	0	84	15	8	2	1	1	8	13	1	0	0	0
17:15-17:30	37	7	1	2	1	0	96	17	7	3	0	2	22	7	1	0	0	0
17:30-17:45	32	12	1	2	0	0	83	22	2	3	0	1	34	8	0	0	0	0
17:45-18:00	37	20	1	1	1	0	93	27	3	4	1	2	35	13	1	1	0	0
Hour Volume	143	46	6	6	2	0	356	81	20	12	2	6	99	41	3	1	0	0
CPU	143	23	6	6	4	0	356	40	20	12	4	12	99	20	3	1	0	0
18:00-18:15	41	27	1	1	1	0	102	31	3	4	1	2	36	18	1	2	0	0
18:15-18:30	63	12	0	2	0	0	88	31	5	5	1	1	34	8	1	1	1	0
18:30-18:45	59	20	4	0	0	0	94	33	3	3	0	1	48	14	3	1	0	0
18:45-19:00	72	17	1	4	0	0	84	27	3	3	0	2	24	27	5	1	0	0
Hour Volume	235	76	6	7	1	0	368	122	14	15	2	6	142	67	10	5	1	0
CPU	235	38	6	7	2	0	368	71	14	15	4	12	142	33	10	5	2	0
19:00-19:15	43	15	1	1	0	0	103	28	5	2	1	3	38	18	1	0	0	0
19:15-19:30	76	14	2	1	0	0	98	21	2	2	0	2	30	18	1	2	0	0
19:30-19:45	40	16	1	4	0	0	84	36	9	1	1	2	38	17	4	1	0	0
19:45-20:00	76	21	4	6	0	0	75	17	4	3	1	1	40	17	0	1	0	0
Hour Volume	235	66	8	12	0	0	360	102	20	8	3	8	146	70	6	4	0	0
CPU	235	33	8	12	0	0	360	51	20	8	6	16	146	35	6	4	0	0
20:00-20:15	61	20	3	2	0	0	81	25	5	1	0	2	34	15	0	2	0	0
20:15-20:30	50	16	5	1	0	0	79	31	7	4	1	1	34	21	1	3	0	0
20:30-20:45	54	21	1	0	0	0	67	19	2	0	0	2	28	13	1	0	0	0
20:45-21:00	52	19	3	1	0	0	73	25	5	2	1	2	31	17	1	2	0	0
Hour Volume	217	76	12	4	0	0	300	100	19	7	2	7	127	66	3	7	0	0
CPU	217	38	12	4	0	0	300	50	19	7	4	14	127	33	3	7	0	0
TOTAL	1280	397	66	54	11	1	2253	620	133	76	22	49	799	410	37	28	3	0
TOTAL CPU	1280	198	66	54	22	2	2253	310	133	76	44	98	799	205	37	28	6	0

POINT 2 : ERMOU-M. ANDRONIKOU (MORNING)																		
TURNING MOVEMENT 1							TURNING MOVEMENT 2							TURNING MOVEMENT 3				
	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses
07:00-07:15	44	8	2	1	1	0	20	0	0	2	1	0	3	0	1	1	0	1
07:15-07:30	46	5	4	5	6	3	12	1	2	2	0	0	0	1	0	0	0	1
07:30-07:45	66	11	9	4	0	3	21	4	1	0	0	1	2	3	1	0	0	1
07:45-08:00	64	9	13	4	3	7	23	1	2	3	0	0	1	1	0	0	0	1
Hour Volume	220	33	28	14	10	13	76	6	5	7	1	1	6	5	2	1	0	4
CPU	220	16	28	14	20	26	76	3	5	7	2	2	6	2	2			
08:00-08:15	68	9	9	8	2	3	37	6	7	3	0	1	0	1	0	0	0	2
08:15-08:30	79	20	20	7	0	3	47	5	5	1	1	0	4	4	0	0	0	1
08:30-08:45	99	19	17	10	4	2	64	5	6	3	0	1	1	3	0	1	0	1
08:45-09:00	94	19	15	9	3	2	55	6	6	5	2	1	2	2	1	1	0	2
Hour Volume	340	67	61	34	9	10	203	22	24	12	3	3	7	10	1	2	0	6
CPU	340	33	61	34	18	20	203	11	24	12	6	6	7	5	1	2	0	12
09:00-09:15	88	19	12	8	2	2	46	7	5	7	3	1	3	1	1	0	0	2
09:15-09:30	107	29	7	7	5	2	46	11	5	3	3	0	2	5	0	0	0	1
09:30-09:45	93	22	9	6	0	2	38	9	4	6	0	1	2	4	0	0	0	1
09:45-10:00	108	23	15	7	2	2	47	7	5	1	4	0	0	3	0	0	0	1
Hour Volume	396	93	43	28	9	8	177	34	19	17	10	2	7	13	1	0	0	5
CPU	396	46	43	28	18	16	177	17	19	17	20	4	7	6	1	0	0	10
10:00-10:15	79	23	13	5	2	2	37	9	9	1	0	1	3	2	0	0	0	1
10:15-10:30	78	35	12	9	5	2	35	13	5	0	0	0	4	4	0	0	0	2
10:30-10:45	87	34	11	6	4	2	55	7	6	2	2	1	3	2	0	1	0	1
10:45-11:00	84	34	12	6	3	2	48	9	5	3	1	1	3	2	0	1	0	1
Hour Volume	328	126	48	26	14	8	175	38	25	6	3	3	13	10	0	2	0	5
CPU	328	63	48	26	28	16	175	76	25	6	6	6	13	5	0	2	0	10
11:00-11:15	80	34	13	6	2	2	40	10	3	3	0	0	2	2	0	1	0	1
11:15-11:30	72	36	9	2	0	2	58	16	9	5	1	0	4	2	0	0	0	1
11:30-11:45	95	22	5	7	5	2	46	10	5	4	2	1	2	2	0	0	0	2
11:45-12:00	96	44	10	9	2	2	37	12	3	3	3	0	2	3	1	0	0	1
Hour Volume	343	136	37	24	9	8	181	48	20	15	6	1	10	9	1	1	0	5
CPU	343	68	37	24	18	16	181	24	20	15	12	2	10	4	1	1	0	10
12:00-12:15	81	31	13	8	5	2	44	12	5	3	0	1	4	3	0	0	0	1
12:15-12:30	87	39	16	6	1	2	37	14	4	0	0	0	2	2	0	0	0	1
12:30-12:45	74	39	14	8	0	3	44	14	2	4	0	1	0	4	0	0	0	1
12:45-13:00	84	37	7	8	1	2	49	20	3	3	0	1	1	5	0	0	0	2
Hour Volume	326	146	50	30	7	9	174	60	14	10	0	3	7	14	0	0	0	5
CPU	326	73	50	30	14	18	174	30	14	10	0	6	7	7	0	0	0	10
13:00-13:15	67	33	9	8	0	2	48	20	6	1	0	0	4	2	0	0	0	1
13:15-13:30	73	35	6	9	4	2	49	14	5	2	1	0	0	6	0	0	0	1
13:30-13:45	93	32	14	4	0	2	48	17	4	6	0	1	2	3	1	0	0	1
13:45-14:00	98	41	13	5	1	3	54	26	5	8	1	1	4	3	1	0	0	1
Hour Volume	331	141	42	26	5	9	199	77	20	17	2	2	10	14	2	0	0	4
CPU	331	70	42	26	10	18	199	37	20	17	4	4	10	7	2	0	0	8
TOTAL	2284	742	309	182	63	65	1185	285	127	84	25	15	60	75	7	6	0	34
TOTAL CPU	2284	369	309	182	126	130	1185	198	127	84	50	30	60	36	7	6	0	68

POINT 2 : ERMOU-M. ANDRONIKOU (AFTERNOON)																		
TURNING MOVEMENT 1							TURNING MOVEMENT 2							TURNING MOVEMENT 3				
	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses	Private Cars	Two Wheeler Vehicles	Small Vans	Large Vans	Vans	Buses
14:00-14:15	102	50	13	5	1	3	59	35	5	10	2		5	2				1
14:15-14:30	92	38	5	7	3	1	72	27	4	7			2	4			1	2
14:30-14:45	103	47	7	7	1	2	55	25	4	4	2		5	12				1
14:45-15:00	94	25	9	4	3	3	54	24	3	1	1		3	3				1
Hour Volume	391	160	34	23	8	9	240	111	16	22	5	0	15	21	0	0	1	5
CPU	391	80	34	23	16	18	240	55	16	22	10	0	15	10	0	0	2	10
15:00-15:15	100	26	9	4	3	4	39	19	4		1		1	3				1
15:15-15:30	85	20	7	2	2	1	38	22	5		1			3				2
15:30-15:45	91	19	5	1	2	1	49	11	1	1			4	3	1			1
15:45-16:00	86	18	5	2	2	1	46	16	2	1	0	0	4	4	1	0	0	1
Hour Volume	362	83	26	9	9	7	172	68	12	2	2	0	9	13	2	0	0	5
CPU	362	41	26	9	4	3	172	34	12	2	4	0	9	6	2	0	0	10
16:00-16:15	80	17	5	2	1	1	42	20	3	1			3	4	1			1
16:15-16:30	81	15	1	2		2	31	13	3	1	1	1		3				2
16:30-16:45	74	14	5	2		2	35	8	1	1	1	1	1	2				1
16:45-17:00	90	24	5	1	1	1	46	11	1	1			1	1		1		2
Hour Volume	325	70	16	7	2	6	154	52	8	4	2	2	5	10	1	1	0	6
CPU	325	35	16	7	4	12	154	26	8	4	4	4	5	5	1	1	0	12
17:00-17:15	83	21	11	2		1	41	7	2				2	4				1
17:15-17:30	102	18	7	1	2	2	41	11	4		2			5	1			2
17:30-17:45	113	27	3	4	1	1	43	8		2				2				
17:45-18:00	120	38	4	5	2	2	59	17	2	1	1	0	3	4	0	0	0	1
Hour Volume	418	104	25	12	5	6	184	43	8	3	3	0	5	15	1	0	0	4
CPU	418	52	25	12	10	12	184	21	8	3	6	0	5	7	1	0	0	8
18:00-18:15	126	49	5	5	2	2	74	26	3		1		6	5				1
18:15-18:30	101	27	5	7	2	1	63	14	1	1			2	6				2
18:30-18:45	128	38	9	3		1	61	25	4				2	3				1
18:45-19:00	106	34	6	1		2	44	13	6	5	1		1	4	1			1
Hour Volume	461	148	25	16	4	6	242	78	14	6	2	0	11	18	1	0	0	5
CPU	461	74	25	16	8	12	242	38	14	6	4	0	11	9	1	0	0	10
19:00-19:15	118	43	7	1	2	3	66	26	2	1			2	3				1
19:15-19:30	107	28	3	1		2	66	27	4				2	3				1
19:30-19:45	109	53	11	3	1	1	56	20	2	3			1	4				2
19:45-20:00	98	36	9	2	3	2	55	19	2	1				5				1
Hour Volume	432	160	30	7	6	8	243	92	10	5	0	0	5	15	0	0	0	5
CPU	432	80	30	7	12	16	243	46	10	5	0	0	5	7	0	0	0	10
20:00-20:15	98	32	7	3	1	2	84	19	2	1			1	4				1
20:15-20:30	103	33	12	1	1	2	51	16	7	1		1		2				1
20:30-20:45	92	29	5			2	65	19					3	7		1		1
20:45-21:00	98	31	9	1	1	2	58	18	4	1	0	1	1	5	0	1	0	1
Hour Volume	391	125	33	5	3	8	258	72	13	3	0	2	5	18	0	2	0	4
CPU	391	62	33	5	6	16	258	36	13	3	0	4	5	36	0	2	0	8
TOTAL	2780	850	189	79	37	50	1493	516	81	45	14	4	55	110	5	3	1	34
TOTAL CPU	2780	425	189	79	74	100	1493	258	81	45	28	8	55	55	5	3	2	68

ANNEX B
SHOP KEEPERS' QUESTIONNAIRE



QUESTIONNAIRE IN SHOPKEEPERS OF ERMOY STREET



A. COMPANY PROFILE

Company name	
Address	
City	
Postcode	
Tel.number	
Contact name	
E-Mail	

A1. COMPANY TYPE

Personal Company	
Store chain	
Franchising	
Dealership	
Other	

A2. STORE TYPE (e.g. drugstore, bookstore, etc)

.....

A3. PREMISES:

a) Privately own

☐

b) Rented

☐

B. DELIVERY

B1. Frequency and delivery unit

a) Daily	b) 3-4 / week	c) 1-3 / week	d) 1-2 /month	e) Other Please describe:
<u>Delivery unit</u> a) Boxes ☐ b) Pallets ☐ c) Other ☐ Please describe:	<u>Delivery unit</u> a) Boxes ☐ b) Pallets ☐ c) Other ☐ Please describe:	<u>Delivery unit</u> a) Boxes ☐ b) Pallets ☐ c) Other ☐ Please describe:	<u>Delivery unit</u> a) Boxes ☐ b) Pallets ☐ c) Other ☐ Please describe:	<u>Delivery unit</u> a) Boxes ☐ b) Pallets ☐ c) Other ☐ Please describe:
Average delivery (pieces).....	Average delivery (pieces)	Average delivery (pieces)	Average delivery (pieces)	Average delivery (pieces)

B2. Loading/Unloading usual time

- a) 07:00-09:00 ☐
- b) 09:00-11:00 ☐
- c) 11:00-13:00 ☐
- d) Other ☐

Please describe:

B3. Delivery transport mean

- a) Transport company ☐
- b) Suppliers ☐
- c) Transfer by own means ☐
- d) Other ☐

Please describe:

B4. Loading/Unloading type of vehicle

- a) Conventional ☐
- b) Fridge ☐
- c) Open platform ☐
- d) Other ☐

Please describe:

B5. Vehicle type per weight

- a) Biaxial truck $t < 3,5$ ☐



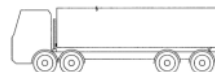
- b) Large Biaxial truck ☐



- c) Triaxial truck ☐



- d) Multiaxis truck ☐



B7. Assessment of Loading/Unloading time

- a) 5-10 min ☐
- b) 10- 20 min ☐
- c) 20- 30 min ☐
- d) Other ☐

B8. Capture of loading/unloading spaces by illegally parked vehicles

- a) Daily ☐
- b) Very often ☐
- c) Often ☐
- d) Rarely ☐

B9. Factors enhancing loading/unloading spaces

- a) Better signage ☐
- b) Law enforcement ☐
- c) Raising drivers' awareness ☐
- d) Reducing parking cost ☐
- e) Other ☐

C. USING NEW TECHNOLOGIES**C1. How familiar are you with technology (computers, Internet services on mobile phones, etc.)**

- a) Too much ☐
- b) Enough ☐
- c) Few ☐
- d) Not at all ☐

C2. Would you be interested in using an online platform through which you could book the loading space for a specified period?

- a) Too much ☐
- b) Enough ☐
- c) Few ☐
- d) Not at all ☐

C3. Do you think the use of such a system would bring positive effects throughout the distribution process of products?

- a) Yes ☐
- b) No ☐

C4. If your answer is “No” please explain why you believe that this system will not yield.

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D. TRAVEL INFORMATION

D1. Way of travel to/from your store

- a) Car as a driver ☐
- b) Car as a passenger ☐
- c) Bus ☐
- d) Motorbike ☐
- e) Bicycle ☐
- f) On foot ☐
- g) Other ☐

D2. What are the main problems arising during your trip?

- a) Long waiting time ☐
- b) Long travel time ☐
- c) Many delays ☐
- d) Difficulty in finding parking ☐

If you use car or bike go to question D3 otherwise you have completed the questionnaire

D3. Where do you park your vehicle

- a) Private/public parking station ☐
- b) Legally in front of my store ☐
- c) Illegally in front of my store ☐
- d) Legally on adjacent streets ☐
- e) Illegally on adjacent streets ☐
- f) Other.....

D4. What are the main reasons for not using parking stations?

- a) There isn't any other nearby ☐
- b) Too expensive for daily use ☐
- c) There are no available spaces ☐

D5. If you were given the opportunity to park in public/ private station with specific payment terms would you choose it?

- a) Yes ☐
- b) No ☐

If your answer is "No" please explain why:

.....

D6. Up to what amount are you willing to pay for the provision of the above services?

- a) 40€/ month ☐
- b) 50€/ month ☐
- c) 60/ month ☐
- d) Other.....