ENERGY EFFICIENT URBAN LOGISTICS: RECORDING AND ASSESSING GOOD PRACTICES

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ABSTRACT

Urban transport today is not sustainable. Although it receives much less attention compared to its passenger counterpart, it can no longer be seen separately from other parts of the transportation chain, due to its resulting negative externalities with respect to the environment, economy and society. To this end, new models for the management of urban freight movements are required, in which local cities authorities and policy makers play a vital role. The objective of the paper is to record and analyse current urban freight transport good practices (GPs) in Europe, with the scope to identify, categorise and disseminate the key mix of push and pull measures for enhancing energy efficient urban freight transport in cities around the world. This involves the analysis of five pilot applications in European cities, complemented by an extensive review of relevant past and current research projects and studies. In addition, a multi-criteria analysis is employed to evaluate the Good Practices collected, which results in the identification of 15 key European good practices, as the most prominent measures successfully implemented in cities to increase both UFT energy and environmental efficiency. The information collected is integrated into one single module, namely the “UFT Good Practice Database”, a structured all-inclusive repository of current practices, which can act as an informative decision-support tool for stakeholders, setting a shared framework for an energy-efficient urban freight transport demand management.

Keywords: urban freight, sustainability, good practices, evaluation

INTRODUCTION

Urban freight transport has increased rapidly in the past decades, against a background of growing freight flows to cater for growing city populations and local industry, together with extending hours of business and leisure activity over the course of the day. Currently, freight vehicles demand progressively more space for delivery and parking, while at the same time compete with other public and private mobility groups under infrastructural limitations of city centres, aggravate congestion, affect adversely the environment, reduce the efficiency of goods distribution and services, and ultimately threaten the quality of a sustainable urban environment. Such challenges are generally common to all European cities (and others in the rest of the world), despite their individual differences in terms of size, geography, infrastructure, and economical, social, political and administrative frameworks.

The majority of studies conducted on sustainable urban transport have traditionally focused on passenger transport. Research on urban freight is recently emerging to address the growing needs, with a number of initiatives being promoted in the last decade to render urban freight transport more sustainable. The European Commission has been pioneering such a focus shift, initially through the adoption of a Green Paper in 2007 (European Commission, 2007), which put forward options to form the basis for a real European policy on urban mobility, and subsequently, through an Action Plan on Urban Mobility. The latter was adopted in 2009 (European Commission, 2012), providing a coherent framework for 20 concrete EU-level actions that can be implemented by the EC in the coming years through existing instruments and initiatives. In particular, through its CIVITAS Initiative since 2002 (www.civitas-initiative.org), the European Commission has assisted several towns and cities to build capacity and develop Sustainable Urban Mobility Plans, through the operation of pilot projects prior to their large-scale implementation, turning bold and innovative new concepts into mature measures.

Despite the above, a large number of cities do not have yet a plan in place for goods distribution for optimising movements at urban level, while several measures already implemented to alleviate any freight transport negative effects have often proved ineffective. At the same time, existing freight policies do not appear to measure up to the important challenges (Dablanc, 2007). On the other hand, big industrial and commercial companies have their own independent systems for goods distribution, which are often in direct conflict with the goals of local administrations. These are called to provide the trade-off between ensuring an efficient distribution of goods answering to the needs of forwarders and retailers, and the necessity to place restrictions and other measures on freight traffic to minimise adverse impacts. Finally, several case studies have proven that there is are no one-size-fits-all or top-down solutions.

The objective of this paper is to identify, record and structure current good practices in energy-efficient urban freight transport (UFT) together with their respective impacts (positive and negative) of implementation, into one single module, namely the “UFT Good Practice Database”, an informative supporting tool for stakeholders that delivers on-demand access to valuable good practice applications and performance benchmarks from several European cities. This is achieved through a complimentary mix of both “theory” and “practice”, that is, an extensive review of current initiatives and projects, as well as the study of 5 pilot cities’ implementations of selected measures.

BACKGROUND

Most recent research behind the issue of sustainable and energy-efficient urban freight transport confirms that knowledge and awareness is relatively low. Many also claim that a holistic understanding of the implications of freight transport in urban areas is lacking; this could be partly due to the complexity attributed to the sector and the far greater set of factors that influence urban freight activity than passenger transport (Allen *et al.* 2012). To this end, a considerable part of the literature still focuses on a qualitative review of the current state of the freight transport in urban areas, identifying the apparent shortcomings in UFT planning (Lindholm and Behrends, 2012), and the main problems observed in cities regarding the movement of goods (José and de Magalhães, 2010), with a view to raise awareness of the need for actions in the urban freight transport area (Behrends *et al.* 2008). Lindholm (2010) approaches the subject from the local authorities' role and implication, highlighting the importance of UFT gaining a higher priority on their agenda, as was the case of London and Paris, where serious consideration was given to freight transport in the last years by the respective Mayors of these large metropolitan centres (Browne *et al.*, 2007). On this matter, Crainic *et al.* (2004) attempted to introduce an organizational and technological framework for the integrated management of urban freight transportation and identify important associated planning and operation issues and models.

Current research is also presenting technical measures, best practices and initiatives, the majority of which have been brought in practice to improve city logistics (Browne *et al.*, 2012; Quak, 2012; Dezia *et al.*, 2010), as well as policy measures and their related operational, financial and environmental effects (Anderson *et al.*, 2005). The Best Urban Freight Solution (BESTUFS) Network, established by the European Commission (www.bestufs.net) is a notable example of research in this area. The project culminated in a series of city logistics solutions and best practice guides, while many other related EU funded projects complement and expand the BESTUFS recommendations.

Many measures to reduce the negative effects of freight transport in cities in Europe and around the world have been implemented and have not been effective, without an ex-ante assessment of the impacts. With regard to UFT measures evaluation, Gonzalez-Feliu and Salanova (2012) defined and evaluated collaborative urban freight transportation systems, simulating the relation of city logistics measures with related outcomes (e.g. reduction of greenhouse gas– CO2 - or air pollutant emissions). Along similar lines, Russo and Comi (2012) carried out an ex-post analysis of results obtained by city logistics implementation around Europe in terms of environmental impacts, and Filipi *et al.* (2012) presented an ex-ante assessment methodology of UFT policies, again with a focus on the assessment of pollutant emissions. Finally, several attempts have been made with regard to modelling urban freight transport demand (Comi *et.al* ,2012), however, these fall beyond the scope of this paper, and, thus will not be discussed.

Based on the above, it is evident that limited research deals with actual solutions and measures for sustainable UFT, while more information is available on projects that have been carried out mainly across Europe. The difficulty, however, lies in adapting implemented solutions to the local prerequisites of each individual city. In addition, few project evaluations have indicated what went potentially wrong with the implementation of UFT measures, increasing the possibility of repeating past mistakes. Finally, there is a need for more broad and extensive information about good practices and policies implementation in order to reach

out to local authorities through knowledge exchange and increased awareness. To this end, the main objective of this paper is to provide more detailed information on specific urban freight good practices implemented in different cities and to present them in such a manner that other cities would be able to explore their potential transferability to their own circumstances. In addition, a multi-criteria analysis, together with a SWOT analysis will indicate the most prominent measures, diagnosing their respective benefits and constraints.

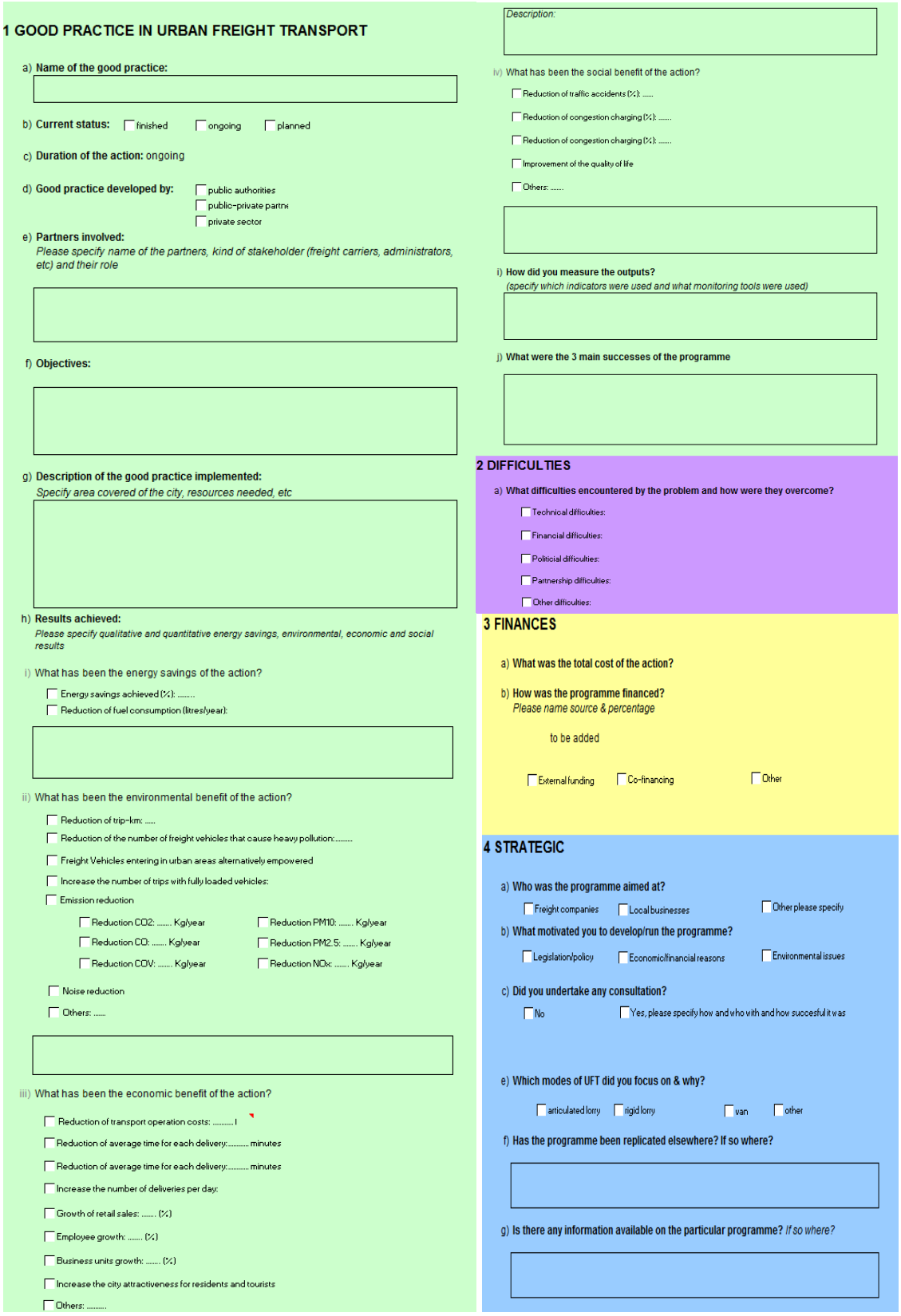
DATA COLLECTION PROCESS

A significant part of the present analysis involved an extensive data collection, for which specific templates were created with a view to capture and record in a systematic manner the most useful information with regard to the good practices identified. The templates were designed to mirror the issue of energy efficient UFT and ensure that only relevant data was recorded that would allow the assessment of all important components of the topic under study. The templates were also designed for the purpose of creating the "UFT Good Practice Database" with the scope to integrate all information collected and present it in a clear, intuitive and directly usable format.

The key template related to the description of a UFT Good Practice is presented in Figure 1, and was structured in the following segments:

- General presentation: The name of the Good Practice, its description and related objectives, the key stakeholders involved, its duration and current status.
- Results: The main results achieved due to the GP implementation, in terms of energy savings and environmental, social and economic benefits. Both quality and quantative data was requested, as well as the monitoring tools and indicators used to measure results.
- Other key considerations: main difficulties encountered in implementing the GP, financing scheme, strategic information with regard to the motivation behind the GP implementation, its target groups, and the possibilities of replication.

With regard to the pilot sites, two additional templates were created in order to obtain key information on the main characteristics of each individual pilot city, its existing freight transport infrastructure, as well as on the areas most congested by freight traffic. Moreover, pilot cities were asked to provide information on their urban freight management policy, in order to determine existing regulations. Finally, direct interviews with public administrations related to UFT were conducted in pilot sites, in order to obtain their opinion on: i) the main problems detected in the cities, ii) the benefits and constraints of the good practices already implemented and iii) the priority measures that would be implemented to achieve a more energy-efficient and sustainable urban freight transport.



1 GOOD PRACTICE IN URBAN FREIGHT TRANSPORT

a) **Name of the good practice:**

b) **Current status:** ☐ finished ☐ ongoing ☐ planned

c) **Duration of the action:** ongoing

d) **Good practice developed by:** ☐ public authorities ☐ public-private partn ☐ private sector

e) **Partners involved:**
Please specify name of the partners, kind of stakeholder (freight carriers, administrators, etc) and their role

f) **Objectives:**

g) **Description of the good practice implemented:**
Specify area covered of the city, resources needed, etc

h) **Results achieved:**
Please specify qualitative and quantitative energy savings, environmental, economic and social results

i) What has been the energy savings of the action?
☐ Energy savings achieved (%): .....
☐ Reduction of fuel consumption (litres/year):

ii) What has been the environmental benefit of the action?
☐ Reduction of trip-km: .....
☐ Reduction of the number of freight vehicles that cause heavy pollution:.....
☐ Freight Vehicles entering in urban areas alternatively empowered
☐ Increase the number of trips with fully loaded vehicles:
☐ Emission reduction
☐ Reduction CO2: ..... Kg/year ☐ Reduction PM10: ..... Kg/year
☐ Reduction CO: ..... Kg/year ☐ Reduction PM2.5: ..... Kg/year
☐ Reduction COV: ..... Kg/year ☐ Reduction NOx: ..... Kg/year
☐ Noise reduction
☐ Others: .....

iii) What has been the economic benefit of the action?
☐ Reduction of transport operation costs: l
☐ Reduction of average time for each delivery:..... minutes
☐ Reduction of average time for each delivery:..... minutes
☐ Increase the number of deliveries per day:
☐ Growth of retail sales: ..... (%)
☐ Employee growth: ..... (%)
☐ Business units growth: ..... (%)
☐ Increase the city attractiveness for residents and tourists
☐ Others: .....

Description:

iv) What has been the social benefit of the action?
☐ Reduction of traffic accidents (%): .....
☐ Reduction of congestion charging (%): .....
☐ Reduction of congestion charging (%): .....
☐ Improvement of the quality of life
☐ Others: .....

i) **How did you measure the outputs?**
(specify which indicators were used and what monitoring tools were used)

j) **What were the 3 main successes of the programme**

2 DIFFICULTIES

a) **What difficulties encountered by the problem and how were they overcome?**
☐ Technical difficulties:
☐ Financial difficulties:
☐ Politicial difficulties:
☐ Partnership difficulties:
☐ Other difficulties:

3 FINANCES

a) **What was the total cost of the action?**

b) **How was the programme financed?**
Please name source & percentage

to be added

☐ External funding ☐ Co-financing ☐ Other

4 STRATEGIC

a) **Who was the programme aimed at?**
☐ Freight companies ☐ Local businesses ☐ Other please specify

b) **What motivated you to develop/run the programme?**
☐ Legislation/policy ☐ Economic/financial reasons ☐ Environmental issues

c) **Did you undertake any consultation?**
☐ No ☐ Yes, please specify how and who with and how succesful it was

e) **Which modes of UFT did you focus on & why?**
☐ articulated lorry ☐ rigid lorry ☐ van ☐ other

f) **Has the programme been replicated elsewhere? If so where?**

g) **Is there any information available on the particular programme?** *If so where?*

Figure 1-Good Practice Template

PILOT APPLICATIONS

A study of five pilot actions carried out in five European cities gave important insight into different types of UFT good practices solutions in cities that cover a wide geographical span and exhibit substantial differences in terms of population, transport infrastructure and administrative and political culture. Pilot actions offer the opportunity of examining directly how urban freight measures are handled within a city, what factors and incentives are important for their adoption and subsequent success or failure, and what other key issues could be hindering the integration of freight transport in the urban transport planning.

Parma

Parma is a historical city in Italy with more than 21.000 inhabitants, as well as a density of population of more than 8.000 people per square kilometre. The area generates high traffic flows of both passengers and goods entering the city centre daily, while the existing network's capacity is no longer sufficient to support these mobility's needs.

The Municipality of Parma has developed a city logistics project named ECOLOGISTICS, with the aim to develop an efficient and innovative urban goods distribution service based on four main aspects, the utilization of logistic platform, the use of an ICT data transmission platform, the implementation of an urban goods distribution service using environment-friendly vehicles and new regulations.

The Municipality of Parma has identified the Centro Agroalimentare e Logistica Consortile (CAL), as an efficient and innovative urban goods distribution service, located in the vicinity of the city's centre, with the scope to consolidate freight, load vehicles and optimize last mile routes. CAL is supported by a data transmission platform with a wireless communication system that consents communication between the platform and the vehicles, optimising thus logistic management. In addition, CAL has activated the ECOCITY initiative that utilises low environmental impact vehicles provided with the ECOLOGISTICS authorization in accordance with the project's requirements. Finally, the Municipality released the ECOLOGISTICS permit (license), which must be obtained by operators, fulfilling a number of requirements, in order for them to be allowed entry to the city centre.

Leicester

Leicester is the ninth largest city in England, United Kingdom, with a population of approximately 300,000 inhabitants, and the largest city in the East Midlands region. Due to the age and development of the city, the main roads are at full physical capacity and cannot be widened or expanded. The main issue for Leicester remains the air quality, having previously been fined by European authorities for the air quality on a number of the major routes into and out of the city being below standard. Two good practices have been implemented, that is, the Leicester Freight Quality Partnership (FQP) and the restriction of urban freight transport routes.

The Leicester Freight Quality Partnership (FQP) is a group of local authority officers, engineers and businesses, the Federation of Small Businesses, the Police, main shopping mall reps, company reps, county reps and other freight interested parties, which has no legal powers, but is essentially a discussion platform, where freight users can air their concerns and needs and in return the authority can notify the parties of the legal and financial remits. Leicester City Council has also initiated a freight mapping on-line facility to assist freight

companies. Clear signage has been installed on bridges and roads to prohibit drivers of large vehicles from accessing certain routes. This allows for better road usage for smaller vehicles and pedestrians, enables the authority to maintain its character / present structure, and prevents road blockages and accidents. Direct contact and discussion with freight distributors allows the authority to better communicate these routes and alternatives. This action was also supported by alternative route signage in the city for large vehicles.

Newcastle

Newcastle is currently the 20th most populous city in the United Kingdom. The compact nature of Newcastle's city centre, with its narrow streets and close clusters of shops, renders freight traffic a serious problem throughout the inner core of the city centre. The city has already implemented two good practices, whilst two more are within their immediate plans.

The Tyne and Wear Freight Partnership brings together transport operators, industry representatives, five local authorities, the University of Newcastle, the Highways Agency and local stakeholder groups to facilitate delivery of a freight strategy and associated Action Plan. The Partnership reviews and advises on progress towards identified tasks and informs the direction and scope of the work carried out.

In addition, a range of online maps in PDF format have been developed, covering key freight destinations and depicting preferred routes for access. Newcastle City Council is now in the process of converting these to interactive maps. By typing in the destination address from a dropdown box for the relevant site, and the origin postcode, a map will be displayed showing the recommended route to that destination.

Finally, the Tyne and Wear's first Freight Consolidation Centre, will be operational in the near future, whilst Newcastle City Council will be working with organisations across the city to develop and implement delivery and service plan frameworks to enable businesses to achieve efficiencient deliveries.

Stuttgart

Stuttgart itself remains small, with 577,232 inhabitants on 207 km^2, however, a number of midsize towns encircle the city today, such as Medieval towns, new industrialized towns, as well as numerous residential and industrialized villages. One relevant good practice has been identified, the Truck Routing Concept "Filder", elaborated by the administration of the main communities.

The idea is to introduce an overall concept, instead of just forcing traffic out of one's own area and into the neighbors' settlements, in order to reduce noise. Most measures have not been established yet. Nevertheless, the routing concept is a joint effort of municipalities and expresses still the joint approach of the communities.

Szczecin

Szczecin is located in North West Poland on the Baltic Sea with a population of 406,000. The good practice implemented in 2009 is Packstations 24/7, an innovative solution beneficial to both customers and on-line stores. The service is a system of post office boxes that can receive packages 24 hours a day, 7 days a week. An individual shopping via Internet, after ordering a package to the Packstation 24/7, receives an SMS and an e-mail with a code of reception. Within two business days following the dispatch, the parcel will be at the packstation, where the recipient needs to type a mobile phone number and receive a code,

for which the delivery locker opens. Receiving packages is possible at any time of day or night. There are 20 packstations currently operating in Szczecin.

REVIEW AND INTEGRATION OF GOOD PRACTICES

Apart from the pilot applications, the analysis included an extensive review of 55 research projects, either elaborated in the last decade, or still on-going, the majority of which were funded by the European Union and/or national authorities. The desktop review identified 23 different types of UFT good practices, divided between soft and hard measures. These are presented in Table 1 together with the number of projects corresponding to each type, while a brief analysis follows herein.

Table 1-UFT Good Practices Classification and No of Projects

Good practices	Number of Projects
Soft Measures	
Access Restrictions	9
Optimization of routes	4
Extending Environmental zones	4
Urban Logistic Plans	2
Freight Quality Partnership	9
Distribution plan/scheme	3
Driver's Behaviour (Eco-driving and on-board computers)	3
Incentives	2
Promotional-incentive campaigns	1
Innovative financing models	1
Advance booking	1
Van-sharing service	1
Mobility credits scheme and electronic passes	1
Alternative delivery systems	1
Freight Exchange	1
Hard Measures	
Use of Intelligent Traffic Management	7
Urban Freight hubs at the edge of the city.	8
Distribution micro-platforms in the inner city	10
Use of environmentally friendly vehicles	14
Use of rail mode as well as suburban rail/metro for delivery and Use of city canals, waterways for delivery (modal shift)	6
IT logistic tools	6
Intelligent Transport Systems	1
Measures to tackle noise	2
Total	**97***

**several projects include more than one GP*

Soft UFT Good Practices

Access restrictions, optimization of routes and the establishment of environmental zones with related UFT regulations are the main soft countermeasures addressed to lead sustainable and energy efficient urban freight distribution. All relevant projects and pilot applications

concluded that there are several environmental, social and economic benefits to be gained. Most European cities have different restrictions regarding weight and type of vehicle. These are often the first and easiest measures to be implemented. Environmental or Low emission Zones are measures that have been introduced more recently in several cities. Nevertheless, positive effects have been reported, increasing the motivation for applying such measures elsewhere.

Delivery time window restrictions and night time deliveries are also simple and cost effective soft measures for reducing congestion caused by urban freight vehicles. Time windows restrictions are generally well accepted and successful for cities, reducing congestion at peak hours and increasing the attractiveness of a city centre. Successful experiences have also been recorded in the case of night delivery, mainly in supermarkets and retail centres, which have a special interest in supplying goods ready for morning opening times. However, operators were required to ensure that vehicle performance in terms of pollution and especially noise meets certain acceptable standards (for vehicles and material handling noise).

In addition, several projects highlighted the importance of direct collaboration with freight operators, and the use of incentives rather than just seeking to restrict access. Incentives, in terms of financial and regulations support are also considered fundamental soft measures, which are useful to stimulate the behaviour of operators towards energy efficient UFT. Regulation incentives are very important in encouraging the acquisition of cleaner vehicles, such as broadening time windows depending on vehicle pollution category, allocating additional freight parking spaces for clean ones, providing priority access lanes to enter the city centre and introducing road pricing policies. An innovative fiscal policy could also consist of reducing auto insurance charge for engine operation, fuel consumption, or the use of alternative propelled vehicles, etc. Best results are achieved when incentives and access restrictions are used simultaneously.

The above measures can be considered as governance measures mainly referring to traffic regulations. A number of them can be considered as short-term policies, such as time windows, loading and unloading zone regulations or traffic limits, but many of them are strategic or tactical measures. Their impacts are on logistics and transport operators that may adapt their fleet or their delivery/pick-up journey to the traffic regulation of the area (Russo and Comi, 2012).

With regard to the role of the local authorities, these are being encouraged by governments to focus their attention on freight transport and include consideration of urban distribution and sustainability by producing Local Urban Logistic Plans, as a strategic approach to initially analyze the freight distribution pattern in the city in hand, and identify the requirements and attitudes of the stakeholders involved, in order to design and implement the most appropriate measures. In addition to the above, distribution schemes/plans intervening on an administrative level can be valuable strategic soft measures to organise an action plan for efficient and sustainable urban freight transport. Such Delivery and Servicing Plans (DSPs) and Construction Logistics Plans (CLPs) are intended to provide a framework to better manage all types of freight vehicle movement to and from individual destinations of all types.

The review has also revealed the importance of establishing Freight Quality Partnerships (FQP). All projects and pilot applications analysed demonstrated that there are clear gains from engaging in cooperation local authorities, regional government, public transport operators, business forums, retailers, logistics companies, vehicle manufacturers, technology

suppliers and researchers. The organisations and groups can all work together towards the broad objectives of energy efficient urban freight transport, can effectively promote new regulations related to UFT, and pave the way towards clean last mile distribution. FQPs can also act as a consultation forum.

Finally, projects and pilot sites highlight the importance of the driver's behaviour in an energy efficient urban freight management system and make recommendations of relevant measures such as Eco-driving support and board computers. Eco-driving can significantly contribute to reducing pollution and fuel consumption, and hence, training sessions for freight fleets should be promoted by cities.

Apart from the above, there are several other innovative soft measures and sustainable distribution opportunities available, albeit with less frequent application, such as the use of promotional-incentive campaigns, innovative financing models, advance booking, mobility credits and electronic passes, alternative delivery systems, freight exchange, etc.

Hard UFT Good Practices

Several projects and pilot applications provide examples of cities that have in place or have trialled hard measures, the most popular being the consolidation urban distribution centres, located at either the periphery of a city, or within its inner centre (distribution micro-platforms), as is the case of Parma and Newcastle good practices. Such measures have mainly strategic or tactical planning horizons and their impacts are abided by logistics and transport operators, however, local government has to support their construction with start-up incentives. Therefore, bundling various trips of one or several carriers to single trips with better capacity usage will result in the following:

- reductions in the number of vehicle trips
- reductions in the number of vehicle miles
- better vehicle and driver utilisation
- fewer vehicles and more suitable vehicles in the urban area
- reduced vehicle emissions and noise pollution
- the ability to use alternative fuel vehicles for "last mile" delivery
- the opportunity to increase recycling of packaging
- improved supply chain management.

Despite the above, the introduction of a consolidation centre introduces one more step in the supply chain with additional handling, and, thus, additional time and cost. To this end, major barriers for joining a scheme include the organisational and contractual problems associated with the set-up and the desire to keep supply chain advantages to one, instead of sharing the service with others (Lindholm, 2012).

The use of environmental zones and related vehicle requirements has helped to stimulate a trend towards the purchase of environmentally friendly transportation vehicles, which is one of the key hard measures identified. The use of alternative fuels sources (e.g. bio-fuels, electric, hydrogen, etc.) is the most commonly used good practice to reduce the negative impacts of city centre deliveries, as depicted by the high number of projects that propose such measures, as well as the pilot application in Parma. The implementation of related good practices yielded in most cases impressive results in terms of reduction of trips, emissions and noise. In addition, the use of alternative fuel vehicles is optimized when employed in conjunction with another commonly used good practice, the urban freight consolidation centres. If, however, environmental zones are established in different cities of the same

region/country, the rules to meet should be the same, in order to avoid confusion among freight operators.

Without doubt, traffic management is an important part of optimised urban freight transport. The use of intelligent traffic management systems in urban freight distribution often in conjunction with eco-driving support to the driver (Parma, Leicester), have also been considered by several case studies with promising results. In developing such measures, however, particular attention should be paid to the fact that different cities have different requirements with respect to traffic management, as well as different ICT infrastructures.

Furthermore, a number of projects analyse successful cases of UFT modal shift, that is the use of rail for urban freight transport, or even short sea shipping and inland waterways, where infrastructure is available. Finally, innovative hard measures implemented include the use of intelligent traffic management systems and IT logistic tools.

The review revealed as a general rule that optimisation of urban freight transport is only possible if a balanced mix of measures is proposed from the beginning, that is, a combination of soft with hard push and pull measures. In addition, the majority of measures require a cooperative approach. This would be much easier to achieve in those measures, which do not require all regional key players to work along the same lines, but can produce good results with a limited number of stakeholders, cooperating on the base of their own interest or incentives. Such approaches may appear limited at first, but they cannot be blocked easily by a few disinterested stakeholders.

GOOD PRACTICES EVALUATION

The data collection obtained from the pilot sites and the European initiatives and projects demonstrated also that, in general, cities do not have analytical tools for evaluating the effectiveness of the UFT good practices implemented, both by means of ex-ante and ex-post evaluation. Moreover, cities do not usually employ UFT indicators for the purpose of quantifying the GP impacts, positive and negative. One of the reasons for this is that there is a lack of role models in Local Authorities regarding urban freight transport issues, focusing in most cases only on passenger transport. To overcome this particular barrier, the paper proposes a Good Practice evaluation methodology, which includes a multi-criteria analysis (MCA), as well as a Strength-Weaknesses-Opportunities-Threats (SWOT) analysis on selected good practices, results of which were validated by relevant stakeholders.

MCA Analysis

A multi-criteria analysis was employed to select from the sum of good practices identified by the review, those 15 yielding the highest score, as the most prominent measures. The criteria selected and related scores assigned are presented in Table 2.

Nevertheless, given the critical need to raise awareness on the differences in cities' possibilities, contexts and allow cities to ascertain the prerequisites required to achieve the same type of results, a SWOT analysis was proposed for the good practices selected. In addition, in order to obtain a complimentary mix of results of good practices, both studied in practice and assessed by the proposed evaluation methodology, the SWOT was carried out for the 15 good practices identified by the multi-criteria analysis, as well as for the good practices of pilot sites.

Table 2-Criteria Scores

Energy saving potential		**Level of transferability of the good practice**	
Unknown data	0 points	Difficult	1 point
0 – 10%	1 point	Medium	2 points
11 – 30%	2 points	Easy to replicate	3 points
>30%	3 points		
Economic benefits		**Degree of innovativeness**	
Unknown data	0 points	More than 7 years' operating	1 point
0 – 10%	1 point	3 – 7 years' operating	2 points
11 – 30%	2 points	< 3 years' operating	3 points
>30%	3 points		
Social benefits		**Level of cooperation**	
Unknown data	0 points	No cooperation or unknown	0 points
0 – 10%	1 point	Public or private cooperation	1 point
11 – 30%	2 points	Public and private	3 points
>30%	3 points		
Cost of implementation of the action		**Availability of documented information**	
Unknown data	0 points	Low	0 points
>750.000 €	1 point	Medium	2 points
50.000 – 750.000 €	2 points	High	3 points
<50.000 €	3 points		

SWOT Analysis

The SWOT analysis applied to the selected GP list raised the following key questions:

- **What are the strengths of the good practice when implemented in the city?**
  This question aims to find the benefits and advantages of implementing a good practice, such as energy savings, environmental, economic and social benefits.
- **What are the weaknesses of the good practice when implemented in the city?**
  This question refers to internal weaknesses, ie. lack of funds, high cost for the implementation of the action, limited access to relevant information, technical difficulties, etc.
- **What are the opportunities of the good practice when implemented in the city?**
  Opportunities faced externally when implementing a good practice, such as external benefits for cities, future environmental benefits for Europe, the future competitive advantages of businesses, etc.
- **What are the threats of the good practice when implemented in the city?**
  Threats refer to future problems and obstacles, and hence, this information can include the future environmental regulations, prospects of the economic conditions or additional financial funds, etc.

Due to space limitations, a selection of outputs is presented in Tables 3-10.

Table 3-Pilot Ste Parma GP

ECOLOGISTICS PROJECT AND ECOCITY SERVICE	
Strengths	**Weaknesses**
▪ Reduction of energy consumption in 825 MWh/year ▪ Reduction of 80.640 litres/years in fuel consumption ▪ Reduction of the number of freight vehicles that cause heavy pollution: 39.345 diesel vehicles/year ▪ Reduction of trip km in 40 km/day. ▪ Reduction of 37.000 kg/year CO2 ▪ Reduction of 300 kg/year CO2 ▪ Reduction of 38 kg/year COV ▪ Reduction of 13 kg/year PM10 ▪ Reduction of 11 kg/year PM2,5 ▪ Reduction of 216 kg/year NOx ▪ Noise reduction ▪ Increase number of trips with fully loaded vehicles ▪ Increase city attractiveness for residents and tourists ▪ Improvement of the quality of life. (A survey was carried out and indicated that 91% of the respondents were satisfied with the Ecologistics service). ▪ There were financial supporters to implement the initiatives: Municipality of Parma, Infomobility, Environment Ministry and Emilia-Romagna Region	▪ Difficulties to achieve a consensus among the local stakeholders about the implementation of an innovative city logistics model. ▪ Initial high cost of the action: 2.050.270,42 €
Opportunities	**Threats**
▪ Availability of new technology to implement other good practices ▪ Continue the implementation of appropriate communication and awareness activities to spread the Ecologistics concept ▪ Contribute to the reduction of the negative impacts of UFT ▪ Transferable to other cites	▪ European economic situation may hinder the implementation of good practices on this field ▪ Changes in the government may affect the priorities in the political agenda, and consequently, withhold financial support

Table 4- Pilot Ste Leicester GP

FREIGHT QUALITY PARTNERSHIP (FQP)	
Strengths	**Weaknesses**
▪ Exchange of information and know-how among public and private partnership. ▪ FQP in charge to carry out urban freight transport surveys and traffic counts ▪ Work with freight operators and other local businesses to develop an understanding of the key freight issues affecting the area ▪ Leicester FQP has experience, they are working together since 2000 ▪ Urban freight transport considered Leicester's Local Transport Plan ▪ Raise awareness and encourage investment in vehicles and good practice generally	▪ Difficulties to achieve a balance between freight transports contribution to economic growth and protecting the environment ▪ Lack of ex-ante and ex-post evaluation data regarding the good practices implemented ▪ Lack of statistical data regarding UFT (e.g. indicators related to urban deliveries)

Opportunities	Threats
▪ Propose new regulation related to UFT to pave the way towards clean last mile distribution. ▪ Transferable to other cites	▪ Space and age of the city can be restrictive to implementing some good practices. Many of the major roads cannot be widened or new diversions cannot be put in place due to the urban development on the sides of these roads ▪ Political changes may affect the importance of UFT in the political agenda

Table 5- Pilot Ste Newcastle GP

TYNE AND WEAR FREIGHT CONSOLIDATION CENTRE	
Strengths	**Weaknesses**
▪ Newcastle City Council receives support and resources from Clipper Logistics and Your Homes Newcastle, reducing financial risks.	▪ High set-up costs: £220,000 ▪ The Freight Consolidation Centre is not in operation yet, so the impacts cannot be evaluated. ▪ The political difficulty lay in securing a formal decision on the funding and remit of the Consolidation Centre. There was political support but securing this into a decision proved difficult at times. ▪ The financial difficulties evolved over a period of time. From the very outset, Newcastle City Council found it difficult to get a clear view of the full financial costs and implications of establishing a Consolidation Centre and the assignment of risk
Opportunities	**Threats**
▪ Reduction in vehicle trips into the city centre ▪ Reduce congestion in the city centre of Newcastle by decreasing the number of delivery vehicles required ▪ Reduce vehicle emissions in the Air Quality Management Area of Newcastle city centre.	▪ Contractual and organisational problems ▪ Monopolistic situations can be created

Table 6- Pilot Ste Szczecin GP

PACKSTATIONS 24/7	
Strengths	**Weaknesses**
▪ possibility to access packages 7 d/ week and 24 hr/d per day ▪ Customers are informed of deliveries via SMS or e-mail ▪ There are 20 Packstations 24/7 ▪ Reduction of freight transport trip km in comparison with attended delivery, thereby reduction of emissions, noise and energy consumption ▪ Low delivery costs	▪ Packstations 24/7 is a private action, and the public authorities do not have information about the impacts ▪ The final leg of the journey has to be made by the customers

Opportunities	Threats
▪ Efficiency gains for logistic providers ▪ Transferable to other cites	▪ Higher freight mileage due to E-commerce growth

Table 7- Night delivery (Barcelona, Spain)

NIGHT AND OFF-HOUR DELIVERIES	
Strengths	**Weaknesses**
▪ Night delivery is a mature good practice in Barcelona(since 2003) ▪ Supermarket operators have interest in supplying fresh foodstuffs ready for when the stores open ▪ Reduced journey times (e.g Condis Supermarket 50% of reduction) ▪ More capacity load, and, therefore less journeys (e.g Mercadona have reduced the number of journeys with a proportion 3 to 1) ▪ Reduces delays for the logistic service providers ▪ Reduces emissions and energy consumption, due to less congestion during night time and direct access to the shops (e.g when the traffic is heavy Condis has achieved 57% of fuel reduction and 53% of emissions reduction) ▪ Increases logistics efficiency in terms of deployment of manpower ▪ Enhances road safety ▪ Optimizes the use of public space (time and space sharing) ▪ Unloading with negligible increase in noise levels, 0,3 dB(A). A part of the night deliveries is done by PIEK material: loading/unloading material and more silent trucks (e.g Condis implemented adapted refrigeration equipment and platforms which produce 60% less noise) ▪ Avoid fines for bad parking ▪ Night deliveries have been extended to other cities of the region (e.g Mercadona has extended to 10 municipalites near from Barcelona) ▪ Good return on investment (1,5 – 3 years). Up-scaling ▪ No complaints from residents ▪ Support of Barcelona City Council	▪ Higher costs for quiet freight vehicles ▪ Higher personal costs for the logistic operator ▪ Higher personal costs due to having to receive the deliveries at night (e.g the cost of Condis Supermarket has been increased about 25%) ▪ Small businesses cannot accept to receive the goods during night times
Opportunities	**Threats**
▪ To develop more experiments in order to increase the number of freight vehicles operating at night ▪ Consider the purchase of EURO 4 and EURO 5 vehicles	▪ Political changes may not support night deliveries ▪ If freight operators don't adapt all the their vehicles, possible complaints of residents may be generated due to high levels of noise

Table 8- City distribution with cargo bikes (Donostia, Spain)

CITY DISTRIBUTION WITH CARGO BIKES	
Strengths	**Weaknesses**
▪ Since September 2010, the company TXITRANS make environmentally friendly deliveries for supermarkets (Eroski) and parcel companies (Egunon, Typsa) ▪ Donostia City Council gives support to the initiative, providing a municipal space to store the goods ▪ Access restrictions to the city centre are not applied: cargo-bikes can go on the road and also use bike lanes, the access to pedestrian zone is permitted during all day, and they can park, load and unload on the sidewalk ▪ Attract new customers ▪ Eroski makes 16.000 deliveries per year with cargo bikes, which estimates a reduction of 12 tonnes per year CO_2 ▪ Delivery times have been reduced about 40%, thus improving the customer satisfaction ▪ Less congestion and less freight vehicles in city centre, which implies a reduction of fuel consumption, emissions and noise level	▪ Not all the goods can be transported by cargo cycles, this delivery is appropriate for weight up to 180 kg and a capacity of 1500 Litres
Opportunities	**Threats**
▪ Develop a campaign to inform more freight operators and shippers on using cargo bikes ▪ Monitor the trip km with cargo bikes, the fuel saving achieved and the emissions reduced	▪ Political changes may terminate the regulation incentives to access the city centre for cargo-bikes, reducing their effectiveness

Table 9- Driver training (Bristol, UK)

DRIVER TRAINING	
Strengths	**Weaknesses**
▪ Support, technical guidance and training tools: 4 fleets and over 40 drivers have been trained ▪ The course is a combination of in- class theory and on-road practical demonstration and coaching ▪ Public and private stakeholders are involved (Bristol City Council, UK Road Safety and freight operators) ▪ UK Road Safety have provided all training and support required for fleets and drivers in Bristol ▪ Eco-driving reduces air and noise pollution ▪ Eco-drivers use 8 to 13% less fuel than drivers without ECO Driver Training experience	▪ It has sometimes proved difficult to encourage participation with smaller fleets as operators are less willing to take drivers off the road for this type of training ▪ Complicated to monitor the driver‘s behavior after training, is without ITS
Opportunities	**Threats**
▪ With fuel prices increasing and with the need to reduce emissions Eco-driving is a step in the right direction for fleet organisations ▪ Good practice easily transferable	▪ Lack of interest by freight operators to make eco-driving training

Table 10- Environmental Zone (Aalborg, Denmark)

ENVIRONMENTAL ZONE	
Strengths	**Weaknesses**
▪ Political support. In 2006 Danish Parliament adopted the law concerning low emission zones (LEZ) in Denmark ▪ LEZ rules are exactly the same in all environmental zones in Denmark (Copenhagen, Frederiksberg, Århus, Odense and Aalborg), avoiding the confusion of freight operators ▪ Environmental Zone encourages the purchase of cleaner freight vehicles, reducing the negative environmental impacts ▪ Economic benefits for trucks manufacturers ▪ The share of trucks with Euro IV increased from 28% in 2008 to 54% in 2010. The trucks with engine standard Euro II have been reduced from 26% to 15% ▪ There is no need to purchase new vehicles that comply with Euro IV, because vehicles retrofitted with particulate traps can also access to the Environmental Zone ▪ By increasing the proportion of vehicles with Euro IV engines, air quality is improved with consequent social benefits ▪ Danish vehicles need a special environmental zone mark in the front window ▪ Meetings with freight operators were conducted before the implementation of the LEZ ▪ Information leaflets were handed out to residents, retailers and drivers, and posters were used for advertising the Environmental Zone initiative ▪ The Police conduct special raids in the zone to evaluate the rules enforcement	▪ A total of 215 trucks, representing 45% of the trucks that were registered in the environmental zone did not comply with Euro IV standard in 2010 ▪ However, it is not possible to get information on whether the vehicle has a particulate filter from the Central Motor Registry (CMR). There are no means at the moment to count the number of filters
Opportunities	**Threats**
▪ Reduction of air and noise pollution, improving the quality of life	▪ Too many freight vehicles can access the Environmental Zone as a consequence of a high percentage of Euro 4 and Euro 5 vehicles. If this happens, it will be necessary to adapt existing rules

UFT GOOD PRACTICE DATABASE

The sum of information collected through the pilot applications, GP review and GP evaluation was integrated into one single module, namely the “UFT Good Practice Database”, a structured and manageable repository of the good practices identified. The database, essentially containing the completed templates, was developed in Excel for Microsoft

Windows, as per the specifications of the C-LIEGE project[1] and related time limitations, with the short-term objective to set up a simple, widely applicable and user-friendly system to collect, record and store information. It also allows for an easy integration in computers that operate any of the usual software programmes. The data base has been made publicly available on the C-LIEGE project's dedicated website (www.c-liege.eu).

The excel document contains the following features:

- 1st Tab/Worksheet- Directory of Good Practices related to Soft Measures: A list of all Good Practices related to soft measures, grouped in accordance with the typology identified for soft measures, together with a code name and unique code number corresponding to each Template.
- 2nd Tab/Worksheet:-Directory of Good Practices related to Hard Measures: A list of all Good Practices related to hard measures, grouped in accordance with the typology identified for hard measures, together with a code name and unique code number corresponding to each Template.
- Tabs 1-93: Completed Templates by directory code number

A snapshot of the UFT Database excel document is presented in Figure 2.

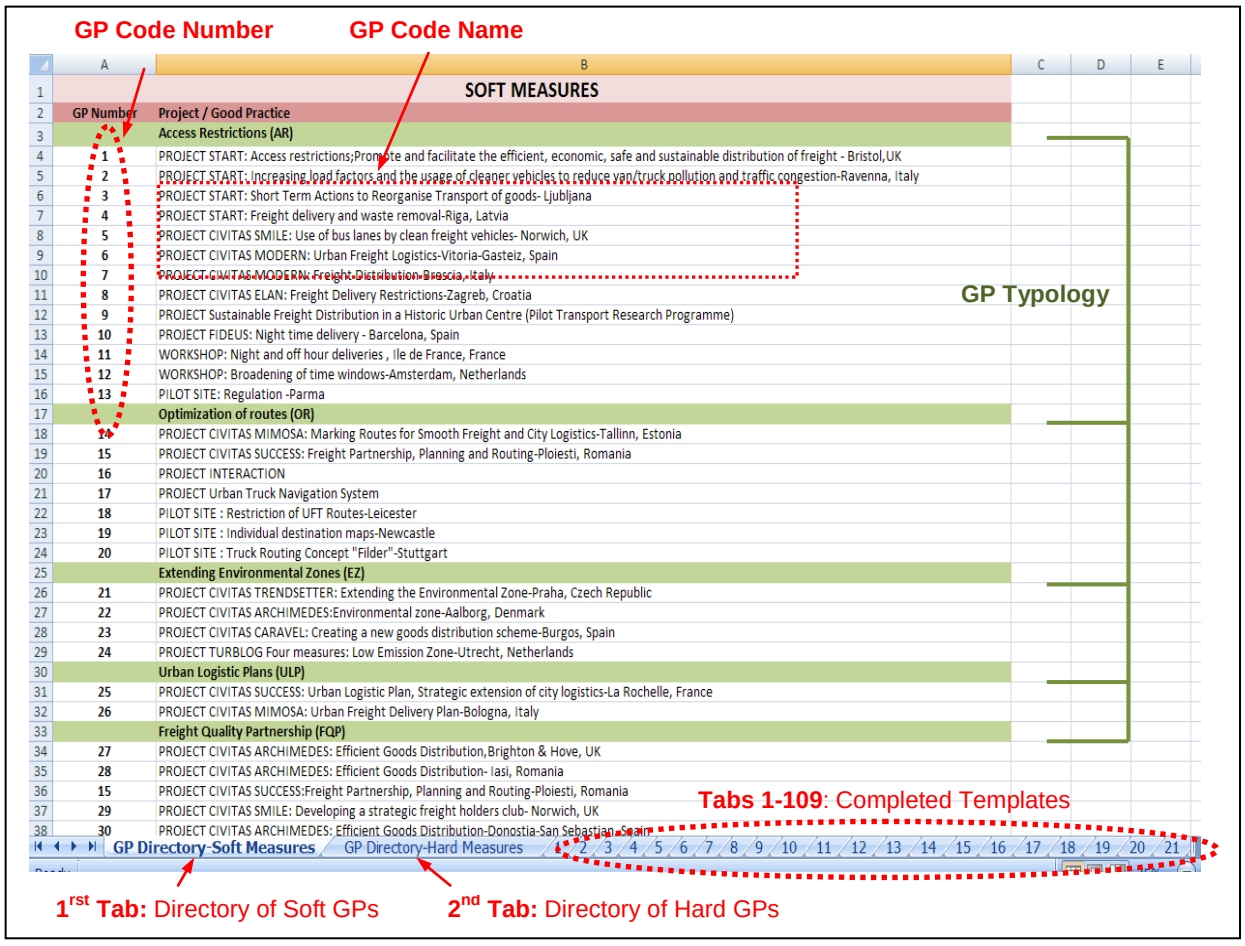


Figure 2-Snapshot of UFT Database

[1] C-LIEGE (Clean last mile transport and logistics management) Project, funded by Programme Intelligent Energy Europe, 2011-2013

Based on the above, the user upon accessing the UFT Database has the opportunity to browse the GP directories, from where one can select the good practice of interest, and by making note of its code number, look up the worksheet containing the template of the selected good practice, where all available information for the specific practice is provided. It should be noted that the results of the SWOT analysis were also included in the database for each selected good practice.

CONCLUSION

The complexity of operations and conflicting policy goals make urban goods transport a controversial sector commanding a shift of attention away from urban passenger transport. The growing recognition of adverse environmental impacts and social and economic externalities, invites both local authorities and the industry to examine good practices in terms other than just freight delivery efficiency. The analysis carried out for the purpose of the present paper gave clear evidence that the level of interest and the resources devoted to improving urban freight logistics operations is increasing year by year and a wide range of pilot tests and established projects and initiatives is widely available. Nevertheless, good practices stand a good chance of being achieved when authorities at a higher level of planning have obtained 'feedback' and understanding of the cause-and-effect of such measures, together with clear directions for each level of activity and proven benefits and constraints.

In light of above, the present paper achieved primarily the following results:

- Identification and structure of measures implemented within the energy-efficient urban freight solutions domain.
- Analysis and evaluation of pilot implementations, as well as results of projects and initiatives, in terms of success criteria, benefits and constraints.
- Detailed presentation of UFT good practices.

The information collected was used to build the "UFT Good Practice Database", an informative decision-support tool for stakeholders, setting a shared framework for an energy-efficient urban freight transport demand management with new ideas and recommendations on policies and planning strategies for developing an energy-efficient urban freight mobility plan. The objective of the database is to disseminate experiences, project relations, good practices and success criteria to a broad public of interested actors, thereby aiming at the transferability of solutions and increase in rate of adoption. The long term objective is to integrate the database into a dynamic tool, whereby users can make enquiries based on the freight transport needs of their individual urban region and identify possible solutions and measures among the good practices recorded by the database to improve the flows of goods in urban areas and reduce the environmental, social and economic impact of the operation.

Finally, it should be noted that the analysis was based on experiences from European cities, which are currently pioneers in UFT measures, however, similar urban structures can be found in the USA and other parts of the world.

ACKNOWLEDGEMENTS

The contents of this paper are based on the elaboration of the C-LIEGE (Clean last mile transport and logistics management) Project, funded by Programme Intelligent Energy Europe, 2011-2013.

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