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Comparative analysis of activities for more environmental friendly urban freight transport systems in Norway and Poland

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Abstract

Negative effects of urban distribution of goods in terms of energy consumption and air pollution are caused mainly by a low level of cooperation between partners in the supply chain, and also the low effectiveness of transport systems. The issues of urban freight transport functioning and effects on the city environment have recently been more and more often taken into account. Many projects on a local, regional, national as well as cross-boundary scale have emerged, with a direct focus on limiting the negative impacts of urban freight deliveries on the environment. In this paper the authors introduce a study performed for Polish and Norwegian cities focused on initiatives concentrated on activities aimed at limiting the negative impacts of freight transport on urban environment. A comparative analysis of the Polish and Norwegian projects was made, taking into account both quantitative and qualitative aspects. This was the first part of the GRASS (GReen And Sustainable freight transport Systems in cities) research project, which is being undertaken by the Maritime University of Szczecin and the Institute of Transport Economics from Oslo through the Polish-Norwegian Research Programme.

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Keywords: urban freight transport; environmental impact; sustainable transport; comparative analysis;

1. Introduction

Depletion of natural resources, significant pollution of all environmental components results in the loss of opportunity for further development of the transport-shipping-logistics due to the dissatisfaction of society. This is

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emphasised by the sustainable transport functioning principles, formulated by the European Commission, underlining the need for (European… 2001, p. 102):

- proper financing infrastructure to enable elimination of "bottlenecks" and linking peripheral areas with central regions,
- political determination to account for and adapt more than sixty measures proposed in the White Book,
- a new approach to urban transport to be taken by local authorities, which will reconcile modernisation of public transport services with rationalisation of private cars use, which in turn will make it possible to meet the international requirements regarding a decrease in pollution, particularly CO_2 emissions, and
- meeting the needs of the users who in return for increased mobility costs are entitled to expect high quality service and full respect for their rights, regardless whether the service is provided by a public or private company, which will make transport services organisations user-centred.

Sustainable transport involves three dimensions used for measuring the success of individual programs and projects, aimed at implementing the assumptions (Rogers et al. 2008, pp. 43-44):

- economic dimension – focused on maximising revenue while maintaining or increasing capital resources,
- ecological dimension – focused on maintaining flexibility and immunity of biological and physical systems, and
- sociocultural dimension – concentrating on maintaining the stability of social and cultural systems.

In this context, the goals of sustainable urban freight transport should be addressed taking into account several vital aspects (Russo and Comi 2012:66):

- in the economic dimension:
  - transport congestion (inter alia, additional time spent in journey, journey time, journey speed),
  - route length,
  - delivery times,
  - infrastructural costs;
- in the social dimension:
  - decreasing the interference between the individual segments of urban mobility (inter alia, cars, trucks, pedestrians),
  - decreasing the number of vehicles engaged in their tasks,
  - decreasing the number of traffic accidents,
  - the city's convenience in terms of living conditions;
- in the environmental dimension:
  - decreasing the pollution,
  - decreasing the noise level,
  - loss of residential space.

The environmental aspect involves mainly pollutant emissions, in particular greenhouse gases and carbon dioxide (using non-renewable fossil fuels contributes to generating waste such as tyres, oils and others). Reduction of greenhouse gases emissions by 20% by 2020 is one of the key targets established by the European Commission. Half of them, derived from road transport, are produced in urban areas. Negative effects of urban distribution of goods in terms of energy consumption and air pollution are caused mainly by a low level of cooperation between partners in the supply chain, and also low effectiveness of transport systems. However, identification of the most effective actions and measures that make it possible to develop sustainable and energy-efficient freight transport systems in cities is a far from easy process, due to the diversified requirements of the parties connected with its functioning. Emissions contribute a large extent to the phenomena of global warming, acid rains, smog and excessive noise. Carbon dioxide is responsible for the greenhouse effect.

Within an hour, a single car turns 6000 litres of oxygen into fumes. To compare, during one hour a medium-size deciduous tree produces 1200 litres of oxygen, and a human uses up 30 litres (www.green-cars.pl/idea.html –

15.06.12). Driving a passenger car for ten kilometres equals emission of 2 kg CO_2 (ec.europa.eu/transport/strategies/facts-and-figures/index_en.htm – 15.06.12). In the West Pomeranian Voivodeship, users of the regional roads emit over 49,000 Mg of carbon oxide, 14,000 Mg of nitrogen oxides and 45 Mg of sulphur dioxide (www.wios.szczecin.pl – 15.06.12). The highest level of pollution derived from transport is found in the main transport nodes of Szczecin, Koszalin, Stargard Szczeciński and Świnoujście. Apart from carbon dioxide emissions, the increase in the number of vehicles leads to a rise in emissions of nitrogen oxides as well air pollution with fine dust resulting from abrasive wear of brake pads, tyres and road surfaces.

The issues of urban freight transport operations and effects on the city environment have recently been more and more often taken into account. Many projects on a local, regional, national as well as cross-boundary scale have emerged, with a direct focus on limiting the negative impacts of urban freight deliveries on the environment. In the course of a study performed for Polish and Norwegian cities, the total of 79 initiatives was identified. The initiatives concentrated on activities aimed at limiting the negative impacts of freight transport on the urban environment. A comparative analysis of the Polish and Norwegian projects was made, taking into account both quantitative and qualitative aspects.

2. Methodology

The study performed for Polish and Norwegian cities focused on initiatives concentrated on activities aimed at limiting the negative impacts of freight transport on urban environment. A comparative analysis was made, taking into account both quantitative and qualitative aspects. It was the first part of research project GRASS (GReen And Sustainable freight transport Systems in cities), which is being conducted by Maritime University of Szczecin and the Institute of Transport Economics from Oslo through the Polish-Norwegian Research Programme.

The objective of the first step of the GRASS project was analysis and comparison of the performance of urban freight transport (UFT) systems and identification of activities (projects, implementations) directed towards more environmental friendly UFT in Norway and in Poland. The basis of these actions were the methods described in Table 1.

Table 1. Comparison of numeric data regarding both countries. Source: own work.

Method	Description	Knowledge sources
Documentary analysis	This method will allow knowledge about present activities at the area of environmental friendly urban freight transport (like projects, implementations, solutions) in Norway and Poland to be explored and assessed	• documents and deliverables prepared under the projects • projects web-sites • data from the project operators and promoters • public media • experiences of the GRASS partners • other available sources
Market research methods such as surveys, structured and in-depth interviews	This group of methods allows knowledge regarding the projects (realized in the past, during realization or planned) in chosen cities to be obtained	• questionnaire
Comparative analysis	This method will be used for comparing the present activities in the area of environmentally friendly urban freight transport utilization in Norway and Poland	• data achieved during the task in GRASS project

The basis for the analysis and evaluation of the measures taken in Poland and Norway with regard to implementing and developing sustainable, environmentally friendly freight transport was the survey with utilising two kind of questionnaires:

- questionnaire to assess the city specificity, and
- questionnaire to assess the projects, consisting of four parts:
  – project description,

- difficulties,
- finances, and
- dissemination.

Additionally according to publicly available data (web-sites, public media) the current and planned projects were identified. This process involved primarily extensive desk research of relevant past and current projects and studies in Poland and Norway based on the two criterions:

- influence on energy efficient urban freight transport, and
- coverage of most types of good practices including both soft and hard measures.

The source of the knowledge at this stage were the data disseminated by European project and programmes (like Intelligent Energy – Europe, 5FP and 7FR operators) as well as data disseminated on national or regional level (by proper ministries, regional administration, municipalities etc.).

The basis for the comparative analysis was the preliminary analysis of activities of cities in both countries. This forms a starting point for comparing the contemplated initiatives and then a basis for formulating recommendations for further work and indicating guidelines for development. The quantitative analysis of the projects aimed at supporting sustainable, environmentally friendly urban freight transport in Poland and Norway was based on a set of indicators, including for both countries, respectively:

- the total number of cities,
- the total number of city inhabitants,
- the city area,
- the mean population density in cities,
- the number of projects broken down into finished, ongoing and planned, and
- the number of projects broken down into categories: push/pull/mix and hard/soft/mix.

3. The survey results

In the course of the aforementioned study, a total of 68 Polish and 11 Norwegian initiatives were identified. They focused on implementing urban freight transport that is environmentally friendly and functions in accordance with sustainable growth principles. This analysis did not include general purpose measures that supported all urban transport subsystems, like traffic management systems.

3.1. Polish results

The area of Poland is 312 679 km², while the total population in the 2nd quarter of 2013 was 38 502 396 people. This gives a population density at the level of 123,137 persons per square kilometre. According to the data from the Polish Central Statistical Office, currently in Poland there are 913 cities, of which (www.stat.gov.pl – 01.01.2014):

- 7 have populations exceeding 400 000 inhabitants (Warszawa, Kraków, Łódź, Wrocław, Poznań, Gdańsk, Szczecin),
- 10 cities with populations from 200 000 to 399 999,
- 22 cities with populations from 100 000 to 199 999,
- 72 cities with populations from 40 000 to 99 999,
- 112 cities with populations from 20 000 to 39 999,
- 186 cities with populations from 10 000 to 19 999,
- 181 cities with populations from 5 000 to 9 999,
- 218 cities with populations from 2 500 to 4 999,
- 105 cities with populations below 2 500 inhabitants.

In the course of the analysis of the projects and undertakings that are being implemented or planned in Polish cities, a total of 68 initiatives were identified. The research was based on the survey method as well as on analysis of public information available on respective websites. The surveys were addressed to cities with poviat (second level of local government administration in Poland) rights. Since the response rate was only 39%, it was necessary to supplement the material with data sourced from documents made available to the public by local self-governments. Additionally, some of the projects presented by the surveyed communes (or gminas - the first level of local government administration in Poland) were not taken into account further on in the analysis due to the fact that they did not pertain to the subject of this research. That was because many cities provided data regarding their activities connected with the functioning the public transportation, rebuilding road infrastructure and the implementation of traffic control systems. Although undoubtedly these activities have a direct or indirect impact on urban freight transport (this in particular regards traffic control systems), due to the general nature of their influence on the transport system they were excluded from further analyses. Thus, only the solutions directly focused on freight transport organisation and deliveries in urban areas were taken into account.

The analysis showed that most often the activities regarding the organisation of urban freight transport focus on the implementation of soft measures of a restrictive nature, and they usually consist in designating restricted traffic zones (Bielsko-Biała, Bytom, Chełm, Gdańsk, Gdynia, Gliwice, Gorzów Wielkopolski, Grudziądz, Jelenia Góra, Kielce, Konin, Kraków, Legnica, Łódź, Opole, Poznań, Przemyśl, Rzeszów, Sosnowiec, Suwałki, Świętochłowice, Toruń, Warszawa, Włocławek) and imposing delivery hours (Bielsko-Biała, Chorzów, Częstochowa, Gdynia, Gorzów Wielkopolski, Grudziądz, Jelenia Góra, Kielce, Kraków, Legnica, Łódź, Opole, Poznań, Rzeszów, Sosnowiec, Toruń, Warszawa, Włocławek, Żory). Additionally, special zones and parking spaces for delivery vehicles were designated in three cities (Gdańsk, Szczecin, Żory), while in Częstochowa and Poznań there are charge systems for vehicles entering the city centre. Kraków and Włocławek were the only ones to provide for organising night deliveries of goods to enterprises located in the city. Apart from banning the freight traffic from selected city centre streets, the city of Toruń restricted trucks of GVW exceeding 18 tonnes from 6:00 to 9:00 a.m. and from 1:00 to 7:00 p.m. In Bielsko-Biała, Kielce, Opole and Rzeszów actions were taken to protect the inhabitants from noise. Gdańsk was the only one among the cities analysed to implement a unified road system to the industrial areas and facilities, which aims at improving transport availability of selected parts of the city, thus contributing to decreasing both the nuisances connected with freight vehicles and to increasing the effectiveness of supply chains functioning within the city.

Most of the initiatives were limited to local areas and were financed from own resources or co-financed under EU programmes. Only a small – on the national scale – part of them were implemented under international research projects or are of implementational nature.

The projects which were implemented under international cooperation, and at the same time the most advanced initiatives in terms of implementation were the projects undertaken in Kraków (Civitas/Caravel II), Bydgoszcz (LAKS Local Accountability for Kyoto Goals), Poznań (SUGAR) and Szczecin (C-LIEGE). However, it should be noted that only the Szczecin project resulted in direct implementation of the chosen solutions.

The project carried out in Kraków contributed to developing a concept of goods distribution within its first ring road and involved three major measures: freight vehicles access control system within the first ring road, implementing ecologically clean vehicles, and the concept of an Urban Logistic Centre. Unfortunately, these measures never entered an implementation phase. A certain consequence of the actions taken is the weight-in-motion system which is currently being implemented. Nevertheless, it must be emphasised that the prepared freight transport development plan for the city of Kraków is one of the first documents of this type in Poland.

The SUGAR project was aimed at analysing good practice in urban freight transport, enabling knowledge transfer between parties involved in the project and preparing plans for future actions. It therefore did not lead to any implementations in Poznań – the partner city in the project.

The analysis took into account the project "LAKS Local Accountability for Kyoto Goals", implemented in Bydgoszcz. The aim of this project was to increase the awareness and responsibility of local authorities, institutions, entrepreneurs and inhabitants so as to contribute to limiting climate change – says Grzegorz Boroń, Deputy Director of the Department of Municipal Services and Environment Protection. The project implementation included a greenhouse gas emissions inventory. Also, energy and fuel consumption in the Municipal Office and its

administrative units was examined. The analyses results helped take actions aimed at decreasing greenhouse gases emissions by 20% by the year 2020.

One of the most advanced actions with regard to sustainable and environmentally friendly urban freight transport was the C-LIEGE project implemented in Szczecin. Under this project, a package of experimental measures was developed, aimed at implementing the following solutions: unloading bays for freight vehicles, relocation of pack stations (alternative delivery systems), promoting eco-driving among freight transport drivers, supporting the existing traffic control system with a mobile application, establishing a Freight Quality Partnership and the function of City Logistics Manager, and also preparing assumptions for developing a local freight development plan for the city of Szczecin. It must be emphasised that among the above mentioned measures the most advanced actions have been taken with regard to streamlining the delivery system offered by the company InPost. Joint effort made it possible to determine more effective locations for selected pack stations and resulted in relocation of four machines and installing an additional one. Under the project, in cooperation with a group of stakeholders, a Freight Quality Partnership was established – the first one in Poland. Currently, it takes the form of a voluntary agreement aimed at taking joint actions to implement solutions enabling the functioning of sustainable freight transport in order to reduce the negative impacts on urban environment of the city of Szczecin and ultimately the Szczecin Metropolitan Area.

Among the currently implemented projects, one of the most complex ones, and based on international cooperation, is Civitas II Plus – the weight-in-motion pre-selection system being implemented in Gdynia. Its goals include, development of "Mobility 2.0" systems and services, introducing electric vehicle solutions that are city and people-friendly, engaging the inhabitants in the process of mobility planning and services quality improvement. The main idea underlying the project is striving to create a sustainable system of urban mobility. It includes many measures, among which, from the point of view of the analysis in question, the issue of key importance is implementing the weight-in-motion pre-selection system.

In Katowice, an international project called Sustainable Urban Mobility (SUM) is being implemented. This undertaking concentrates on improving the local air quality, solving congestion problems, and resources preservation by implementing local and regional policies on sustainable mobility in cities. Even though it does not concentrate directly on freight transport, due to the considerable focus on reducing negative impacts of transport on the environment it was included in the analysis. The project is aimed at alleviating serious problems such as greenhouse gases, energy dependence and low quality of air, which affect health as well as the quality of life of citizens living in urban areas. In selected European cities, the Sustainable Urban Mobility project will also promote guidelines for urban planning involving more sustainable mobility, so as to enable gradual replacement of traditional vehicles with electric ones. By adopting a coordinated strategy for sustainable mobility, electric vehicles will be integrated with other ecologically clean means of transport.

3.2. Norwegian results

Norway is a slightly bigger country with the area of 385 252 km². Its total population at the beginning of the 3rd quarter of 2013 amounted to 5 096 300 people, which results in the population density of 13,228 persons per square kilometre. Thus, Norway is one of the countries with the lowest population density ratios. According to the data from the Norwegian Statistical Office, in Norway there are 45 cities with populations exceeding 10,000 (www.ssb.no – 20.02.2014). The capital city, Oslo, is the only one with a population exceeding half a million. Currently in Norway there is a total of 97 cities, of which:

- 1 city with a population exceeding 400 000 people,
- 1 city with a population from 200 000 to 399 999,
- 3 cities with populations from 100 000 to 199 999,
- 12 cities with populations from 40 000 to 99 999,
- 17 cities with populations from 20 000 to 39 999,
- 22 cities with populations from 10 000 to 19 999,
- 28 cities with populations from 5 000 to 9 999,
- 9 cities with populations from 2 500 to 4 999, and

- 4 cities with populations below 2 500 inhabitants.

In the 2nd quarter of 2013, the number of Norwegian city-dwellers was 3 146 026, which is about 62% of the country's total population. Consequently, the mean population of Norwegian cities amounts to nearly 34 572 inhabitants.

Among the evaluated projects, two stands out as particularly important: (1) Green Freight Distribution in Oslo (a project with the Norwegian acronym GBO) and (2) Strategies and Measures for Smarter Urban Freight Solutions (STRAIGHTSOL). The reason is that these two projects combined demonstrations and a consistent methodology in which the effects of the demonstrations are evaluated. Both of these projects focus on urban freight transport in Oslo. Within each demonstration, different measures are tested.

For STRAIGHTSOL the demonstration consists of two measures combined: (1) real time monitoring of parcels to different shops located in the same shopping center, and (2) a buffer storage solution, in which shops receive a text message when the parcel arrives at the buffer storage, and can choose for themselves when they want the parcels delivered to the shop. The buffer storage is located near the parking lanes for the freight trucks and ensures a more efficient unloading procedure. Real time monitoring of parcels works as an incentive for shops to accept the new solution. The demonstration, consisting of five shops, turns out to give a slight net benefit. However, this benefit is expected to increase in a scaled scenario where more shops are willing to participate. Effects of scaled scenarios are currently being assessed in STRAIGHTSOL WP6, and therefore not all the results are available yet.

The project GBO has two demonstrations, of which one is conducted and one is still in the planning phase. The conducted demonstration shows how electric vans can be utilised in Oslo for parcel distribution within Ring 2. The demonstration is conducted by Bring, part of the public Norwegian postal service that is in charge of express deliveries. According to the demonstration, electric vans are a viable option for distribution of light parcels; however, there is still uncertainty related to the long-term effects. This is particularly related to the lifetime of batteries under Norwegian conditions (steep hills and low temperatures) and the value loss of the electric vans over time.

The second demonstration, still in the planning phase, is a combination of an urban consolidation center located centrally in Oslo, and access restrictions to a nearby street. The consolidation center will serve deliveries from vans, while the access restriction will prioritize trucks in a limited period each day. The negative effects for vans as a result of this access restriction will be counteracted by the possibility to deliver to the consolidation center instead. As the demonstration is still in its planning phase, no results are achieved yet. The project has, however, conducted an a priori evaluation of access restrictions, which shows that this is likely to be a beneficial measure in congested streets in Oslo located in commercial zones.

The rest of the reviewed projects can roughly be divided in two groups. The first group are theoretical projects. These projects describe different measures and map their benefits, or collect data to describe either a particular problem or weaknesses with the current situation. However, the measures that these projects are describing are rarely implemented. The reason is either that the relevant actors are not included in the research process, or that even though more efficient solutions overall can be found, it is difficult to find solutions on which all relevant actors are able to agree.

The second group of projects are measures implemented by the local authorities without a consistent procedure for evaluation. These measures usually seem to improve the situation, but without a proper mapping of the current situation and an assessment of different alternatives, the implementations may result in sub-optimal adaptations. It is reasonable to believe that a proper analysis would improve some of the measures. It is equally reasonable to believe that analyses could have identified opportunities of transferability between different urban areas in Norway, as urban freight transport in different cities often struggle with the same problems. However, because of lack of evaluation, none of these transferability benefits are realised.

4. Comparative analysis of activities in Polish and Norwegian cities

4.1. Quantitative analysis of measures

Table 2 shows numeric data to compare the number of projects implemented in Poland and Norway.

Table 2. Comparison of numeric data regarding both countries. Source: own work.

	Country:	Poland	Norway
	Total number of projects	*68*	*11*
Cities	total number	913	97
	total number of inhabitants	*23,339,550*	*3,146 026*
	mean number of inhabitants	*25,676*	*34,572*
	mean area (km^2)	*23.75*	*50.02*
	mean population density	*1081.09*	*691.16*
Ratios	number of project per number of cities	*0.07*	*0.11*
	number of project per 1 million of city inhabitants	*2.91*	*3.50*
	number of projects per mean population density	*0.063*	*0.016*

In view of the total number of projects implemented, undoubtedly there have been more of them in Polish cities. However, if we account for the fact that the number of cities in Poland is much bigger than in Norway, the ratio of the number of projects and the total number of cities shows that a better result has been achieved in Norway. Similarly, Norway has a better ratio of projects carried out per the total population. The ratio of the total number of projects per 1 million of city dwellers is 3.50 for Norway, and 2.91 for Poland.

The quantitative analysis of finished, ongoing and planned projects in the two countries' cities shows that Norway is on the lead.

The results presented herein constitute basis for comparing the measures taken in Polish and Norwegian cities with regard to implementing solutions facilitating development of sustainable urban freight transport. Based on the results of the survey method research and the analysis of data available on the cities' and European projects' websites, this document presents the general picture of the initiatives taken in both countries.

It must be stressed that many a time the cities did not show much involvement in assisting in data sourcing. This problem mainly pertained to Polish cities. The research process showed the fragmentation of competences and difficulties with data sourcing, which resulted from the fact there were many different sources of them. The analysis conducted has led to a conclusion that it is reasonable to postulate that city administrations should include specialised units focused on ongoing supervising the functioning of urban freight transport. The concept was formulated under the C-LIEGE project. The function of City Logistics Manager, proposed under the project, would make it possible to source similar data, which in turn would enable better analysis and assessment.

4.2. Qualitative analysis of measures

The basis for the qualitative analysis of projects aimed at supporting sustainable, environmentally friendly urban freight transport in Poland and Norway is their classification according to their status (finished, ongoing and planned), and category (push/pull/mix and hard/soft/mix). Table 3 includes the classification of initiatives divided into two criteria:

- the nature of the implemented solutions:
  - soft measures – focused mainly on promotional, organisational actions and activities connected with information sourcing;
  - hard measures – they usually mean infrastructural undertakings, based mainly on implementing new technologies, technical systems and undertakings that are complex in terms of implementation (such as urban consolidation centres, urban hubs etc.);
  - mixed solutions combining the features of both aforementioned groups;

- enforceability of the solution application:
  - push measures – imposed on operators in order to influence their operations or deliveries; these can be divided into financial instruments (e.g. higher parking fees and tolls), and technical or regulatory restrictions (e.g. access restrictions); they are closely connected with more efficient and fairer valuation of transport, according to which its users (including freight operators) are required to incur proportionally higher transport costs, including the costs of environmental pollution, accidents and infrastructure wear and tear;
  - pull measures – aimed at promoting more sustainable and cost-effective freight traffic by offering the operators or forwarders various extra services (e.g. specialised road maps), facilities (e.g. preferential access to unloading bays for ecological vehicles) or incentives (e.g. access to priority lanes); in many cases the solutions are combined with information and promotion campaigns aimed at enhancing their effectiveness;
  - mixed solutions combining the features of both aforementioned groups.

Table 3. Comparison of projects broken down acc. to status and category. Source: own work.

Country:			Poland	Norway
Projects	in total		***68***	***11***
	as per status	finished	*16*	*5*
		ongoing	*50*	*6*
		planned	*2*	-
	as per category	push	*56*	*5*
		pull	*5*	*1*
		push&pull	*7*	*5*
		hard	*1*	*4*
		soft	*65*	*6*
		mix	*2*	*1*

Additionally, the projects were analysed in the context of kinds of measures taken (Table 4). The following project groups were distinguished:

- Time windows for deliveries;
- Access restrictions – access restrictions for loading/unloading operations as well as for moving/circulating related to the type of transport means, and most commonly to vehicle emissions, weights and sizes, as well as preferred truck routes and designated lanes;
- Special zones and parking spaces for delivery vehicles (unloading bays),
- Charge systems for vehicles entering the city centre – limiting the access of freight vehicles to an urban area by making freight operators 'pay' for each access with mobility credits that were initially distributed by the public administration (or money payments for entries in excess of the assigned credits). Access control equipment in freight vehicles record every entry to the zone and permits the implementation of a mixed pricing/enforcement scheme for different users;
- Early/night deliveries – organising deliveries during the night or early in the morning,
- Noise protection – measures taken to reduce nuisance resulting from noise (e.g. installing acoustical barriers),
- Special urban planning conditions – integrating sustainable transport conditions into the land use and urban planning process, e.g. by making special freight traffic related contractual arrangements (including enforcement powers) a precondition for a new business or large complex to receive a building permit;
- Weight-in-motion pre-selection system – introducing a system of vehicle classification based on weighing them in motion,
- Alternative delivering systems – implementing various forms of deliveries that are alternative to traditional transport performed by means of freight vehicles fuelled with conventional energy sources (e.g. pack stations, delivery points).

Comparison of the initiatives implemented in Polish and Norwegian cities brings out several major differences. In Poland, major measures concentrate on organisational solutions based on restrictions. The most frequent measures

taken in Polish cities are restricted traffic zones. To a large degree, this is due to the cities topology and the possibility to separate a core centre, often featuring historical buildings and streets with insufficient capacity. Measures of this sort are often combined with time windows for deliveries. In the case of the analysed Norwegian cities, restricted traffic zones were implemented in three of them.

An important feature of the solutions implemented in Norway is the bigger focus on hard measures, such as application of electric vehicles, measures taken under the STRAIGHTSOL project, CO_2 free mail deliveries, customer adapted waste management with electric vehicles. In that regard, Polish cities do not come out so well. The key measures of a similar nature are the weight-in-motion pre-selection systems in Kraków and Gdynia.

It must be emphasised that in Polish cities there are no measures focused directly on implementing solutions based on alternative energy sources. In practical terms, the only measure of this type was eco-driving promotion in Szczecin, however, as it was a voluntary action, and its impact was much more limited compared to e.g. application of electrical vehicles for deliveries.

Virtually all the analysed Polish projects were initiated by local self-governments. The only exceptions are the projects: SUGAR (implemented by the Institute of Logistics and Warehousing in Poznań) and C-LIEGE (initiated and implemented by the Maritime University in Szczecin). In Norway, though, the major part of the initiatives was taken by institutions other than self-governments. In that regard, the major part was played by the Institute of Transport Economics (Transportøkonomisk Institutt) based in Oslo.

The financial sources of the projects implemented in Poland usually include funding from the local or regional administration units. Only in five cases the projects were financed with the EU funds (EU's financial instrument LIFE, Sixth Framework Programme, Seventh Framework Programme, European Regional Development Fund, Intelligent Energy Europe). In the case of the Norwegian projects, the most frequently used source of financing was Norwegian Regional Research Fund as well as the communities own funds. The STRAIGHTSOL project, in turn, was financed under the Seventh Framework Programme.

The initiatives are usually adopted and implemented by communes being the sole partners in the projects. In the case of Polish cities, only the projects implemented under the EU programmes involve a bigger number of partners, however, it must be noted that this pertains to the total number of partners, and so it is not related directly to the projects implementation in a given city. The exceptions are:

- Civitas Dynamo project, implemented in Gdynia, where a local consortium was established involving Gdynia Municipality, Gdańsk Technical University, University of Gdańsk and PKT (Trolleybus Operating Company) in Gdynia;
- Civitas Caravel project, implemented in Kraków, where the local consortium includes Kraków Municipality, the Tadeusz Kościuszko Technical University in Kraków, City Transport Company, Forms Group;
- SUGAR project, implemented by the Institute of Logistics and Warehousing in Poznań in cooperation with the city authorities.

Moreover, the C-LIEGE project was implemented in Szczecin, and one of its goals involved the development of freight quality partnerships. The Maritime University in Szczecin (MUS), a member of the consortium implementing the C-LIEGE project, managed to engage many local stakeholders (even though they did not have the direct status of project partners).

In Norwegian cities, cooperation between several partners was effected mainly in the case of three projects:

- STRAIGHTSOL, involving mainly the Institute of Transport Economics from Oslo and GS1 Norway;
- Grønn bydistribusjon in Oslo, involving 9 - 10 local partners;
- “Strategy for 50% reduction in GHG emissions from freight distribution in Oslo by 2020”, jointly implemented by the Commune of Oslo and the Institute of Transport Economics.

Table 4. Comparison of projects broken down according to solution types. Source: own work.

Measure type	Poland		Norway	
	no.	cities	no.	cities
Time windows for delivering	*19*	*Bielsko-Biała, Chorzów, Częstochowa, Gdynia, Gorzów Wielkopolski, Grudziądz, Jelenia Góra, Kielce, Kraków, Legnica, Łódź, Opole, Poznań, Rzeszów, Sosnowiec, Toruń, Warszawa, Włocławek, Żory*		
Access restrictions	*27*	*Bielsko-Biała, Bytom, Chełm, Gdańsk (2), Gdynia, Gliwice, Gorzów Wielkopolski, Grudziądz, Jelenia Góra, Kielce, Konin, Kraków, Legnica, Łódź, Opole, Poznań, Przemyśl, Rzeszów, Sosnowiec, Suwałki, Świętochłowice, Toruń (2), Warszawa, Włocławek*	*3*	*Oslo, Kragerø, Bergen*
Special zones and parking spaces for delivery vehicles	*3*	*Gdańsk, Szczecin, Żory*		
Charge systems for vehicles entering the city centre	*2*	*Częstochowa, Poznań*		
Early/night deliveries	*2*	*Kraków, Włocławek*	*1*	*Oslo*
Noise protection	*4*	*Bielsko-Biała, Kielce, Opole, Rzeszów*		
Special urban planning conditions	*1*	*Gdańsk*		
Weight-in-motion pre-selection system	*2*	*Gdynia, Kraków*		
Alternative delivering systems	*1*	*Szczecin*	*1*	*Trondheim*
Promotion of environmentally friendly UFT	*1*	*Szczecin*	*1*	*Oslo*
Establishing the Freight Quality Partnership	*1*	*Szczecin*		
Urban Consolidation Centres			*1*	*Oslo*
Utilization of electric vehicles			*2*	*Oslo, Stavanger*
Strategic planning (local freight transport plans)			*1*	*Oslo*
Other actions:	*4*	*Bydgoszcz* (LAKS Local Accountability for Kyoto Goals), *Kraków (Civitas/Caravel II), Katowice (SUM – Sustainable Urban Mobility), Poznań (SUGAR)*	*1*	*Oslo (STRAIGHTSOL)*
Total	*68*		*11*	

Summing up, it may be stated that cooperation between urban freight transport stakeholders in Norwegian cities takes place within a larger scope than in the case of Polish cities. The C-LIEGE project was one of the first initiatives in Poland which underlined the significance of this kind of cooperation, and the need to find consensus for the often conflicting expectations of various stakeholder groups.

However, it is hard to compare volumes of the funds spent on the projects implementation. Insofar as in the case of the Norwegian projects we have financial data regarding only two of them, on the Polish side relevant data were obtained from only seven cities.

It should be emphasised that in the course of acquiring the data many Polish cities indicated solutions concentrated on implementing traffic control systems and ITS. However, due to the fact that they were not directly connected with freight transport functioning, they were excluded from further analyses.

5. Conclusions and recommendations for future works

The general conclusion resulting from the analysis is that the measures taken in Norwegian cities are, to a considerably larger degree, focused directly on the aspects of reducing the negative impacts on the environment and decreasing the use of conventional fuels. Implementation of energy-saving and pollution-reducing solutions is still a challenge for Polish cities. Concentrating only on restrictions regarding access to specified urban zones shows effectiveness that is limited mainly to the given zone and it has a smaller impact on achieving a sustainable, energy-saving urban freight transport on the city scale.

The discussed analysis made it possible to emphasise the differences between Polish and Norwegian cities with regard to implementation of projects focused on developing sustainable, environmentally friendly freight transport. Despite a considerable number of analysed Polish projects compared to Norway, it must be stated that in view of the number of cities in both countries, there should be proportionally more initiatives of that kind in Poland. Additionally, the initiatives taken up in Norway more often focus directly on implementing solutions that facilitate reduction in pollutants emissions, inter alia via application of alternative energy sources. In Poland there are virtually no projects that promote application of alternative fuel vehicles in freight transport. Undoubtedly, it is very important to establish restricted traffic zones, nevertheless, this makes it possible to reduce pollutants emissions in one place only. One of the major problems regarding the pollution in medium-size and big conurbations is atmospheric emission of anthropogenic origin, where the main emitter is the transport system, due to its nature seen as a line source of emission. Therefore, it is necessary to increase activity in the area of implementing alternative sources of energy and promoting environmentally friendly vehicles. Currently there are more and more proposals of this type, including:

- freight vehicles fuelled by:
  - natural gas,
  - bio-fuels,
  - fuel cells using "solar" hydrogen or methanol,
  - electric and hybrid drive,
- freight bike transport,
- inland water transport,
- rail transport.

One of the key problems connected with the urban freight transport functioning is the heterogeneity of the environment of its operation, resulting from varied expectations of stakeholders. Different interest groups have different priorities and goals, which translates into different perceptions of the notions of transport and cargo distribution effectiveness in urban areas. The expectations of suppliers (most often entrepreneurs) are focused first and foremost on cost minimising, which consequently leads to searching for solutions that generally enable minimising the delivery time on the one hand, and maximising delivery volumes on the other. Delivery time and volume are also important for recipients, however, it must be noted that recipients comprise two major subgroups – entrepreneurs (mainly retailers and service outlets) and individual customers who at the same time are usually the city inhabitants (i.e. its direct users) – which means they have interests that are in conflict with those of suppliers. In particular this involves the inhabitants who undoubtedly would like to receive their goods (e.g. ordered via the internet) as soon as possible, but on the other hand they also demand maximum life quality standards in the city, which includes the possibility of undisturbed moving around the city both on foot and by means of public transportation as well as by individual means of transport, and also a reduction in noise and pollution levels within the city. These expectations are often in opposition to the needs with regard to delivery speed and meeting the entrepreneurs' expectations.

The major conclusion drawn from the said analysis is therefore the need to intensify activities aimed at better cooperation between urban freight transport stakeholders. It is important that the implementation processes engage, as far as possible, representatives of major stakeholder groups, such as (Taniguchi et al. 2001: 3-4; Lepori et al. 2010: 18):

- Shippers – this group includes both senders and recipients of goods, usually retailers (small shops independent of large retail chains), wholesalers and manufacturers; these are customers using the services of freight carriers, who send goods to other companies or private customers as well as collect cargoes from them, they are interested in maximising the level of service they receive, including the costs, loading time, shipping time, transport reliability as well as receiving information;
- Freight carriers – this group includes, inter alia, professional third party transport operators, logistic services providers, courier companies, private suppliers (e.g. retailers who independently organize deliveries to their stores using their own transport), administrators of urban delivery centres and dispatchers; representatives of this group are usually interested in minimising the costs connected with collecting goods and delivering them to customers, which makes it possible for them to maximise their profits, they are under a considerable pressure to provide a high level of service at the same time keeping the total costs relatively low, this is particularly important when the expected deliveries are dependent on specified time intervals;
- Residents – this group includes city centre and suburbs dwellers as well as other city users (e.g. commuters or visitors, who actually do not live in the city), people coming to cities to do shopping as well as any other urban traffic participants such as shop owners, developers, associations and organizations of citizens and consumers; this group is not favourably inclined to delivery trucks entering the city even if the vehicles supply them with products, this is due to the fact that the group expects minimal congestion, low noise and pollution levels, and also a decrease in accidents;
- City administrators – this group includes administrators of the urban system of goods distribution (regional authorities, municipalities, administrators of urban delivery centres), other administrators, entities providing inputs to the system (urban planners, decision-makers, infrastructure administrators) and the supporting institutions (e.g. chambers of commerce, city associations etc.); this group of stakeholders is focused first and foremost on the city development and increasing employment opportunities, this group is also interested in limiting the congestion and the environmental impact of transport on the city, they should be neutral and play a major part in solving any conflicts between the other stakeholder groups engaged in freight transport in cities.

Additionally, there is one more group to be named in this context, which is included in CITYLOG and CITYMOVE projects, namely truck & vehicle manufacturers (Lepori et al. 2010:18; Roissac 2010:18). This group is important to the extent that it includes mainly the companies that supply transport systems with components that are necessary for its functioning – the freight vehicles (hardware), and also software to support or even enable their application. In the light of the new concepts in cargo distribution technology in cities (pack stations, freight trams, and in the future underground freight transport, etc.) it is reasonable to extend this group to include producers of innovative technological solutions connected with deliveries.

The C-LIEGE project was one of the first initiatives in Poland which underlined the significance of this kind of cooperation, and the need to find consensus for the often conflicting expectations of various stakeholder groups. One of the most important outcomes of the project was developing the framework for establishing a Freight Quality Partnership. The experience will be put to use under the GRASS project, so as to develop direct cooperation in Szczecin and prepare documents to support establishing such initiatives, taking into account the local conditions of Polish and Norwegian cities.

Freight Quality Partnerships are a kind of an understanding between territorial administration units and other stakeholders, specifying the manner of cooperation in order to solve specified problems connected with freight transport. Its main task is improving the knowledge and understanding of freight transport issues, promoting good practices and effective solutions, while taking into account the needs of individual stakeholders regarding goods and services accessibility, as well as the social and environmental conditions. The concept has been working very well in the UK, where urban logistics issues have been in focus for many years and where there have been many effective implementations of solutions designed to level off the negative impacts of freight transport on urban structures. The challenge faced by a Partnership is, first and foremost, effective promotion of sustainable and safe freight transport in order to satisfy the needs of the local communities and businesses. The partnerships operate on the “pull” principle, i.e. they are based on a voluntary declaration of participation and willingness to apply the results and to adopt conditions connected with it, rather than imposing any restrictions.

Both in Polish and Norwegian cities, activities aimed at establishing Freight Quality Partnerships will make it possible to implement projects in such a way so as to cater for interests of various groups of freight transport users and city users.

It is also important to work out (via, inter alia, Freight Quality Partnership) some mechanisms that will offer significant support for decision-makers in selecting solutions, taking into account the division into three elementary application areas (Konstantinopoulou et al. 2010):

- the area of logistics, comprising measures focused directly on logistic processes organisation, such as:
  - cooperative measures – based on cooperation between businesses, aimed at decreasing the number of trips (e.g. by way of deliveries consolidation), and the main factor decisive for their application is the problem of less-than-truckload deliveries (LTL); the basic form of activity here is the cooperation between carriers (horizontal cooperation), aimed at increasing effectiveness of trips (which in turn improves the city's transport availability, decreases the congestion and contributes to reducing the pollution); the initiatives are nevertheless difficult to implement in practice due to the frequently observed reluctance of businesses to cooperate with potential competitors, while improving the social and pro-ecological image of the company is not always a sufficient incentive;
  - improved route planning – these activities refer mainly to the use of VRP (vehicle routing problems) software, to better reflect the reality (inter alia, taking into account the historical data on traffic hindrances, restrictions resulting from the decisions of city administrators, planning to enable trucks to arrive on time by avoiding congested city areas, etc.), better adjustment to the events (real time planning, taking into account current information on the traffic, available in advance so that it is possible to reroute and reduce the number of kilometres to be covered during the journey);
  - implementing consolidation centres – over the recent years many different cities experimented with various forms of consolidation centres; the solutions are similar to cooperative measures, but the difference here is that the key role is played by jointly used facilities (consolidation centre);
  - application of specified freight units – in order to facilitate consolidation, some special, normalised freight units may be applied; their application is dependent on the reloading forms (e.g. consolidation centres, intermodal transport etc.); the main idea is based on using urban containers adjusted to the urban transport specificity and the transport needs;
  - applying intermodal transport, various means of transport, underground transport – solutions of this type are now relatively rare;
- the area of political decisions – on the one hand these measures are intended to reduce the onerousness of freight transport functioning in cities by way of establishing restrictions in the freight vehicles use (which contributes to road safety improvement and reduces the risk of damaging the infrastructure and buildings), determining time windows and zones for freight vehicles (which reduces nuisances for inhabitants connected with freight vehicles traffic), introducing low emission zones and environmental zones (which reduces local emission of traffic pollutants such as PM_{10} and NOx), inspecting the degree of cargo capacity use (very difficult to assess, but may contribute to decreasing the number of vehicles in city centres), dedicated routes for urban delivery vehicles (to reduce impact of freight vehicles on the whole urban space, thus also decreasing the costs of roads maintenance); on the other hand there are solutions aimed at increasing the efficiency of urban freight transport (the solutions presented so far were focused on decreasing the nuisances connected with its functioning), most often connected with spatial planning and comprising e.g. use of bus lanes by freight vehicles, ensuring sufficient unloading space in city centres (such places are made available for urban freight transport vehicles and they may not be used as parking spaces by other vehicles), ensuring enough space for the needs of urban freight activity (including reorganisation of urban centres) and spatial planning that ensures better availability for transport to facilities requiring numerous transport operations;
- the area of technology, comprising:
  - solutions based on implementing vehicle technologies, focused inter alia on such improvements to vehicles so as to limit the onerousness of their functioning, developing vehicles that are better adjusted to the specificity of urban environment and designing ecological vehicles that use fuels other than petrol or diesel;

- IT solutions, based to a large extent on intelligent transport systems, which may be applied to improve the traffic stream flows in urban transport (e.g. better control of traffic lights systems), solutions of this type and availability of real-time information on traffic will be able to contribute to improving urban freight transport in the future; IT solutions may also regard carriers (e.g. improve route planning or inform on current conditions on the roads and regulations); it is also important to apply telematics in communication between carriers and recipients, which may increase the logistic efficiency (e.g. by avoiding situations when the recipient is away and there are repeated unsuccessful attempts to deliver a parcel).

Another conclusion drawn from the analysis is the need to intensify efforts regarding acquisition of funds to finance initiatives connected with developing environmentally friendly urban freight transport. The new financial perspective of the European Union offers numerous opportunities. In the years to come, the Work Programme named "Smart, green and integrated transport" will be particularly important. This programme is structured in four broad lines of activities aiming at:

- Resource efficient transport that respects the environment. The aim is to minimise the transport systems' impact on climate and the environment (including noise and air pollution) by improving its efficiency in the use of natural resources, and by reducing its dependence on fossil fuels,
- Better mobility, less congestion, more safety and security. The aim is to reconcile the growing mobility needs with improved transport fluidity, through innovative solutions for seamless, inclusive, affordable, safe, secure and robust transport systems,
- Global leadership for the European transport industry. The aim is to reinforce the competitiveness and performance of European transport manufacturing industries and related services including logistic processes and retain areas of European leadership (e.g. such as aeronautics), and
- Socio-economic and behavioural research and forward looking activities for policy making. The aim is to support improved policy making which is necessary to promote innovation and meet the challenges raised by transport and the societal needs related to it.

These activities are addressed in this Work Programme by three Calls for proposals:

- Mobility for Growth,
- Green Vehicles, and
- Small Business and Fast Track Innovation for Transport.

The most important areas from the environmental friendly urban freight transport perspective are the areas addressing transport integration specific challenges (technical and socio-economic), included into the call Mobility for Growth, especially area number 5, called Urban Mobility. This area includes topic MG.5.2-2014. "Reducing impacts and costs of freight and service trips in urban areas". The specific challenge of this topic is, in addition to advances in vehicle technology, achieving essentially CO_2-free city logistics will require significant improvements in the efficiency of goods, waste and service trips to reduce negative impacts and costs. This will require, among others, an improved knowledge and understanding of freight distribution and service trips and the development of best practice guidance on innovative approaches and how to replicate them.

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