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Analysis of freight transport demand at Szczecin and Oslo area

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Abstract

The main problem arising in the process of management of the transport and distribution of goods in urban areas is the lack of data regarding deliveries, in particular with regard to the structure of demand as well as the classification of vehicles, their routes, changes in demand for transport, etc. The paper introduces the results of analysis of the goods distribution within the city centre of Szczecin and Oslo, covering a significant number of companies, retail and service entities, entities of the HoReCa sector, schools, universities, and public administration. The studies are part of research carried out under the project GRASS (Green And Sustainable freight transport Systems in cities). The studies presented in this paper were carried out in two stages. The first stage of work included carrying out initial research allowing for an assessment of the current status in the analysed areas of Szczecin and Oslo. In the second stage of the survey results were updated with data on the increase in demand for delivery in the Christmas period. Moreover, the survey was conducted in the shopping centres located in the designated area of the city. This enabled to determine the seasonal increase in demand for freight deliveries.

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1. Introduction

The dynamic development of transport in recent years constitutes an important factor in the economic development of the world, but it is also a source of problems, which can be observed especially in urban areas.

Mobility plays a very important role in ensuring the sustainable development of the city. Urban transport systems generate many positive effects. In addition to the unquestionable importance for the development of urban economy, urban transport systems assist in the formation of the local community, which has a positive impact on counteracting social exclusion. This manifests itself mainly in the fast and easy access to places of culture (theaters, cinemas, museums, parks, etc.). However, air pollution emitted by motor vehicles in urban areas is an important source of contamination of the atmosphere. Approximately 70% of energy is consumed and approximately 80% of greenhouse gases is produced in urban areas (Istituto... 2008). In the years 1990-2000, carbon dioxide emissions by road transport increased by 23% (Zaloga 2013). This constitutes a serious threat to human health, natural resources, as well as the quality of the raw materials necessary for the production of food.

A growing number of city users results in increased demand for cargo. The largest share of this is generated by industrial, retail and service entities. This applies in particular to finished products; however, due to the location of these entities in urban areas, it also applies to raw materials and semi-finished products. Distribution function initiated by these entities causes an increase in the logistics flows on a limited area. This leads to a situation in which the impact of urban freight transport on the urban environment becomes more and more significant. Research carried out in London show that approx. 18% of traffic in the city is generated by delivery cars supplying these entities. The next 22% of the traffic on urban roads is generated by delivery cars and carriers, which provide services for individual customers by delivering orders personally. The research also shows that some of the deliveries carried by different carriers/ delivery cars intersects and is performed at partial use of the loading capacity (Browne and Baybars 2004). In addition, one of the key problems of transport in the cities is congestion, understood as the overflow of transport network and means of transport caused by exceeding their capacity or its deficiency (Mendyk 2009), which is responsible for the increase in air pollution, energy consumption, but also for longer travel time.

While assessing the impact of UFT (urban freight transport) on the environment, the first step should involve making a division between the first-order and second-order impact (Cullinane and Edwards 2011):

- the first-order impact concerns stakeholders directly involved in the UFT (wholesalers, carriers, handling service);
- the second-order impact concerns e.g. the costs of infrastructure (roads), especially in underdeveloped countries, which causes interference with the environment and global warming.

The continuous increase in the number of motor vehicles, and above all, their exploitation, not only causes the emission of pollutants from exhaust gases, which are endanger human health, but it also reduces reserves of oil. In recent years, a very important issue becomes the reduction of pressure of transport on the environment and the scale and scope of its negative effects. Actions in this area should be conducted on different levels of government and self-government authorities with the collaboration of the private sector. On the one hand it becomes necessary to implement appropriate legal and administrative regulations, on the other hand, to develop the appropriate management of urban space. Urban planners must take into account the needs of residents in terms of employment, health, education and transport needs, as well as provide recreational facilities, shopping places and waste management plants.

The aim of the research presented in the paper is to fill the lack of data regarding demand for deliveries in Szczecin (Poland) and Oslo (Norway). The studies was the part of the project GRASS (GReen And Sustainable freight transport Systems in cities), which is realized by the Maritime University of Szczecin and the Institute of Transport Economics from Oslo through the Polish-Norwegian Research Programme. Activities undertaken as this part of the project are focused on the acquisition and analysis of data regarding functioning of the delivering of goods in the centre of Szczecin and some chosen parts of Oslo, including the provision of transport services in terms of delivery to the four main categories of entities: retail entities, HoReCa, service entities, and production plants.

2. Research objectives

The main problem arising in the process of analyzing the functioning of the transport and distribution of goods in cities is the lack of data on their implementation, in particular with regard to the classification of the vehicles, their routes, the level of demand for transport, etc. In the area of urban freight transport, data can be classified according to three basic criteria (Taniguchi *et al.* 2001):

- variability:
 - static (fixed),
 - dynamic (variable);
- reliability:
 - deterministic (certain),
 - probabilistic (random),
 - diffused (ambiguous);
- sources from:
 - public sector (road and area administrators),
 - private sector (carriers or customers).

Major difficulties in terms of implementation of urban freight transport solutions result from problems associated primarily with the processes of data acquisition. This issue should be analyzed from two perspectives (Iwan 2013):

- acquisition of data directly for the implementation of good practices and implementation of this process in accordance with the principles of benchmarking;
- acquisition of data and generation of knowledge resources for later functioning of the system.

Lack of possibility in obtaining relevant data, or lack of skillful identification of its sources, will cause a situation in which even with proper development of indicators it is not possible to make direct comparisons and thus select good practices for implementation. This, in turn, implies the need to make correct identification of the necessary areas of expertise, data sources, processes and related economic conditions. The main reasons of difficulties in obtaining these data include the following facts (Taniguchi *et al.* 2006):

- urban deliveries involve mainly private companies, which usually do not want to share data on their transactions, supplies and transported goods with their competitors and the public sector;
- there are no standardized research methods in the field of urban freight deliveries.

The first aspect is especially problematic. The fact that private companies, performing the vast majority of transport within the city, do not want to share data on the type of delivery, the degree of load capacity utilization, routes, etc. mainly results from concerns about maintaining a competitive position in the market. Therefore, the analysis of the impact of solutions on the urban environment and the functioning of the companies involved in the distribution processes within cities becomes quite difficult. Lack of data on transport routes, and in particular their length, makes it troublesome to determine the extent to which these processes are carried out.

This paper aims at filling the information gap in the functioning of urban freight transport. The planned tasks focused on the acquisition and analysis of data on the implementation of freight in Szczecin and Oslo, while the research focused on the provision of transport services in terms of delivery to the four main categories of entities:

- retail entities,
- HoReCa,
- service entities,
- production plants.

The results of the research help to understand the present situation in Szczecin and Oslo and map the expectations of users of urban freight transport systems.

3. Results of the analysis in Szczecin

In the research, there were identified 884 entities the operation of which generates traffic of delivery vehicles in the surveyed area of Szczecin. The survey was conducted among 69% (610 entities), while 31% (274) of entities refused to take part in the survey (Fig.1).

490 of the entities that took part in the survey receive regular deliveries. The remaining part of 120 entities reported that the number of received deliveries depends on the need to restock.

The research have shown that 175 entities receive deliveries of no more than 200 kg and 250 entities receive deliveries between 201-600 kg. 120 entities reported that the size of deliveries is between 601-1000 kg, 55 entities 1001-1500 kg, 5 entities 1501-2000kg, and 5 entities receive deliveries of more than 2000 kg. Additionally, more than 70% of retail entities reported a demand for deliveries between 201-600 (34%) and 601-1000kg (38%). More than 50% of business entities from HoReCa sector generates a demand for deliveries between 201 kg and 1000 kg (39% between 201 and 600 kg and 22% between 601 and 1000 kg). In the case of service entities, the size of deliveries received by 45% is between 201-600 kg per week. The greatest size of delivery is received by production plants. In this category, a weekly size of delivery of 65% entities is between 1501 kg and 2000 kg.

This information was used to calculate the total average number of deliveries per week within the surveyed area and it amounted to 5486, the majority of which concerned deliveries to retail entities (2758, the average of 7 weekly deliveries per one entity).



Fig. 1. The area covered by the survey.

The number of business entities was used to calculate the average number of deliveries per individual streets. The largest number of deliveries are made at streets Wojska Polskiego (680), Piłsudskiego (516), Jagiellońska (518), Wyzwolenia (425), Jana Pawła II (416), Śląska (322). The research have shown that 86% of deliveries are made by small trucks up to 3.5 T. The remaining 12% is made by vehicles from 3.5 T to 12 T. The only 2% of deliveries are made by big truck over 12 T. The largest part of the deliveries are made for retail entities; it's more than 50% of all deliveries made in the study area. Given a weekly delivery schedule, the largest part of own transport deliveries was made on Thursdays 27%, Mondays 18% and Fridays 17%. The smallest part was made on Sundays 1% (Fig. 2).

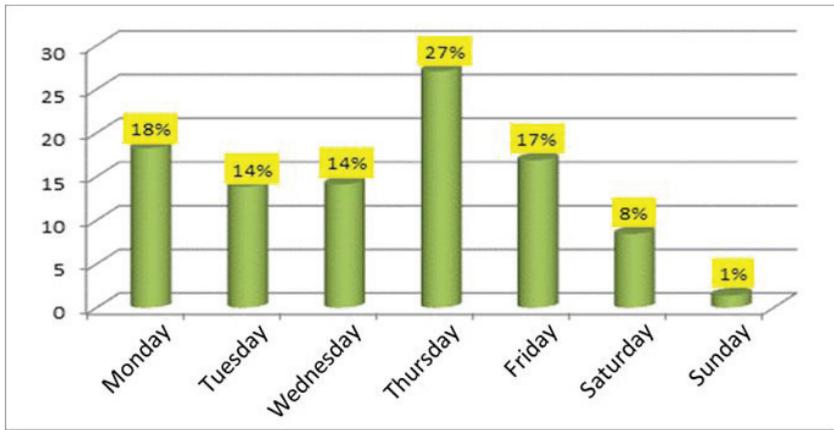


Fig. 2. Percentage of weekly deliveries made by own transport divided into days of the week.

The largest part of third party transport deliveries was made on Mondays 24%, Wednesdays 20% and Fridays 20%. The smallest number was made on Sundays 1% – the same as in case of own transport deliveries.

An important part of the questionnaire conducted in the surveyed area of Szczecin was identification of the most important problems for freight transport, which – according to the respondents – occur in the surveyed area (Fig 3).

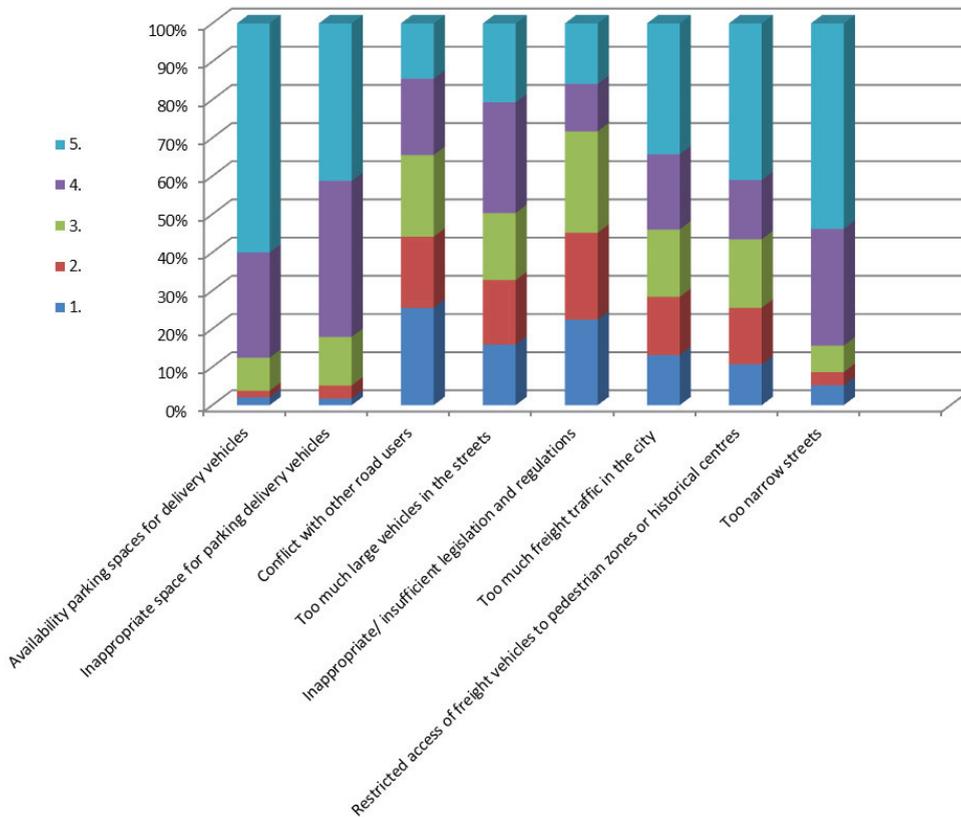


Fig. 3. Overview of challenges faced. Distribution of answers for each question, where 1 means less important and 5 means very important.

Research has shown that the most significant issue in the surveyed area is poor availability of parking spaces for loading and unloading, and parking spaces for delivery vehicles. Another issue is inappropriate space for parking delivery vehicles. Conflicts with other road users (mainly related to difficulties in loading and unloading of goods) were on the third position in the overall assessment. Less burdensome was also presence of large delivery vehicles on the streets in the surveyed area, resulting from the occurrence of large transit traffic in Szczecin. Insufficient legislation was rated similarly and mainly manifested in the lack of regulations, which take into account the needs of freight transport (e.g. such as the reduction of parking fees collection, while delivering goods). As relatively small problem in the surveyed area business entities see restricted access of freight vehicles. Undoubtedly, it is associated with the fact that there are only a few zone of this type in Szczecin, which is primarily due to the morphology of the city. The least burdensome respondents considered to be insufficient road traffic capacity resulting from too narrow streets.

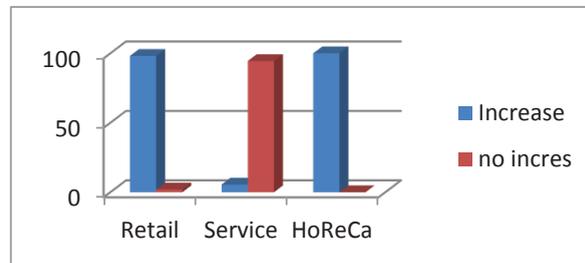


Fig 4. The size of shipments to entities located in the shopping centres in the Christmas period.

Additionally, the analysis of deliveries during Christmas period was realized. This part of the survey aimed to determine the changes in the number and volume of deliveries in the Christmas period. An increase in deliveries was declared by 52% of retail entities, 54% of HoReCa entities, and 50% of service entities. The remaining entities, which did not declare an increase in deliveries, including 7% of retail entities, experienced an increase in the volume of deliveries in the range of 60% to 90%. The increase in both the number and volume of deliveries was declared by 80% of retail entities and 100% of entities from HoReCa sector and production plants. This increase ranged from 30% to 100%. A small group of entities experienced two or even three-fold increase in the demand for deliveries – Figure 4.

4. Results of the analysis in Oslo

The questionnaire was translated to Norwegian and used in the interviews of business entities in Oslo in the period June-July 2014. 40 independent business entities as well as 60 business entities located at a shopping center chose to participate. The main reasons for not participating was heavy workload, absence of owner/daily manager and lack of knowledge about the freight deliveries.

The interviews were conducted in three main shopping streets within the city center of Oslo; Grendsen (17 interviews), Bogstadveien (16 interviews) and Karl Johan (7 interviews) (Fig. 5). The remaining 60 interviews were conducted at the shopping center Stovner Senter.

Out of the 40 business entities that chose to partake in the survey, 20 were retail entities, 11 were service entities and 9 were in the HoReCa sector. The reason why no wholesale entities or production plants were interviewed is that none exists within the city center of Oslo. From the shopping center, 51 were retail, 3 were service and 6 were HoReCa businesses.

33 of the 40 independent business entities and 47 of the 60 entities at the shopping center had regular deliveries to their business entity. 50% of the independent entities had deliveries with an average size of less than 200 kg. 30% had average deliveries of 201-600 kg, 12.5% had deliveries between 601-1000 kg, 5% had average deliveries of 1001-1500 kg and 2.5% had average deliveries of more than 2000 kg. The exact same pattern was visible for entities located at the shopping center with one notable exception; entities at the shopping center received a slightly smaller

share of deliveries between 1001 and 2000 kg, and a slightly larger share of deliveries above 2000 kg. This is most likely due to a larger turnover at the shopping center. Not surprisingly, retail entities seem to receive a larger share of small deliveries, while the HoReCa industry receives the largest deliveries.

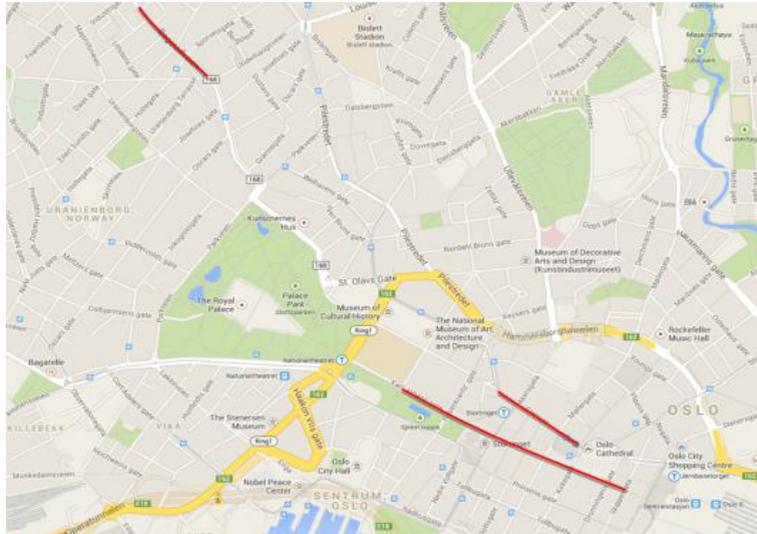


Fig. 5. Map of Oslo with marked streets covered by the survey.

Most of the deliveries to independent entities are from within the city (11) or from within the region (12), while some deliveries also come from elsewhere in the country (8) or abroad (9).

The average number of shipments per week varies from service industry (4.6 shipments) and retail industry (4.7 shipments) to HoReCa industry (5.3 shipments). 17 of the 40 independent entities receive shipments at least daily. Approximately half of the deliveries are done by van, and only one independent business entity receives deliveries by large trucks (greater than 12 tonnes), most likely because these vehicles are too large to be suited to the driving conditions within the centre of Oslo.

Shops located at the shopping center receive deliveries more frequent and with larger vehicles. There may be numerous reasons for this. First, it is more convenient to use large vehicles for the shopping center deliveries due to better infrastructure and less narrow streets. Second, shops located at the shopping center have a higher turnover, so they have a greater demand for transport services. Third, numerous shops located at one shopping center, often using the same transport service providers, will to a greater extent facilitate consolidation of deliveries.

When it comes to time of day, most business entities (55%) reported to receive freight shipments between 7:00 and 16:00. However, freight shipments are reported as early as 4:00-6:59 and as late as 22:00-00:59. Deliveries to the shopping center have to be done during opening hours, i.e. all deliveries to the shopping center are conducted between 7:00 and 16:00.

Some business owners felt they had too little insight into the challenges faced by freight transport in the city center, that they either did not want to rank the main problems identified by the survey, or ranked the problems that were not visible to them as 1 (less important). For example, one business entity in Bogstadveien thought that lack of appropriate marking of the freight transport parking was a significant problem, while another business entity – on the same street – was unaware of any problem with parking for freight transport. The challenges cited by the business owners could also vary quite significantly independent of location. The results regarding 14 different challenges are displayed in (Fig 6).

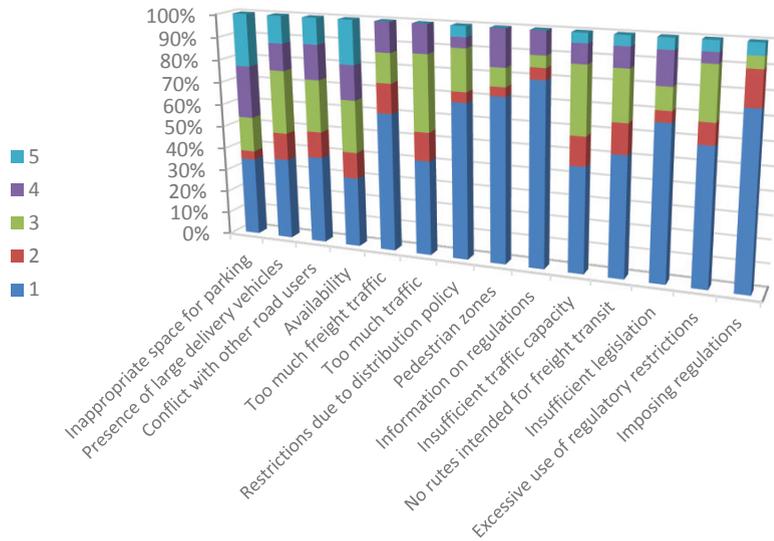


Fig. 6. Overview of challenges faced. Distribution of answers for each question, where 1 means less important and 5 means very important.

The problems with UFT specified by the business entities were very local: few had any strong opinions on the main problems of freight transport that they couldn't see. Some of the problems identified and specified by the business entities were not recognized, or mentioned, by their next door store; thus one could argue that some of the problems for freight transport as seen by business owners are very local. One store might have a parking opportunity that the next door store lacks. The one store would then argue that lack of parking is a significant problem, while the next door store will claim that parking is an unimportant problem.

To get more information regarding deliveries during Christmas period, the entities from the first stage survey were interviewed a second time right after Christmas. Four entities did not answer the second stage; of these two were out of business (had closed down) and two did not have business managers available to answer the questionnaire.

Only 26% of the business entities saw an increase in number of deliveries a week in the Christmas period. But 60% did have an increase in volume of deliveries. It seems that from this relatively small sample of business entities, a lot of businesses chose to solve the increase in sales by increasing the volume of each delivery without increasing the number of deliveries. How this varies between different types of entities is shown at Figure 7.

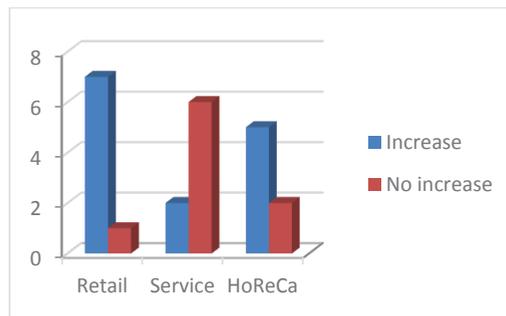


Fig. 7. Increase in deliveries during Christmas period.

Out of business entities that operate in the service industry, only 1/4 saw an increase in volume, and only 1/8 had increased deliveries. None of the hairdressers or opticians saw an increase in either number or volume of deliveries. The hairdressers stated that the number and volume was just as normal, and the opticians experienced a slight decrease in the Christmas period.

Approximately 30% of the entities in the HoReCa sector did not have an increase in deliveries or volume of deliveries in the Christmas period. They explained this with their location and usual customers. An explanation for this is that these entities were usually frequented by students, who were noticeably less likely to come during the Christmas period. The 70% that had a noticeable increase in volume were frequented by shoppers. Only one HoReCa entity also experienced an increase in number of deliveries. This is a popular café, very likely to be more frequented by Christmas shoppers.

Only one of the retail entities did not experience an increase in either number or volume of deliveries. This shop would stock up before the Christmas shopping began, and have a decrease in deliveries during the Christmas period. Apparently, this is an efficient solution for minimizing the workload for the staff in a busy period. The other retail entities that answered the questionnaire experienced an increase volume of deliveries, and 50% also experienced an increase in numbers of deliveries.

5. Summary and conclusions

The dynamic development of transport in recent years constitutes an important factor in the economic development of the world, but it is also a source of problems, which can be observed especially in urban areas. Presented in paper research allows for the observation of the major problems in terms of delivery in Szczecin and Oslo. Analysis allows to identify difficulties in UFT indicated by the respondents. The study allowed to identify changes in the demand for deliveries during Christmas time. In that time in Szczecin showed the seasonal increase in the volume of deliveries usually in the range of 60-90%. Two- or even three-fold increase in the volume of deliveries in this period was usually declared by retail entities, HoReCa sector and over 60% of production plants.

Regarding Christmas deliveries in Oslo, the entities that experienced an increase in volume of deliveries did not necessarily experience an increase in number of deliveries. Out of the entities that experienced an increase in volume of deliveries, only 40% also had an increase in number of deliveries. The remaining entities relieved the increased sales by increasing the volume of each delivery. Retail entities are more likely to experience an increase in deliveries, while service entities are least likely to experience an increase. HoReCa entities frequented by shoppers seem to experience a large increase, while other HoReCa entities often experience a decrease (in particular the entities mostly frequented by students).

Obtained information should be basis for city managers in making decisions about the organization of traffic in the analysed cities.

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