URBAN LOGISTICS SYSTEMS AND NIGHT GOODS DELIVERY

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Abstract: *This paper presents the reasons for relocating logistics systems into peripheral area of a city and the possibilities of their return into urban areas. The implementation of efficient and architecturally modern city terminals and their connection to logistics systems in the fringe areas by more ecological transport modes are crucial for successful return of logistics into central urban areas. Also, this paper states the main advantages, disadvantages and types of night delivery. Considering recently set aim to reduce freight transport during peak hours, there is a tendency to perform logistics activities at night. The purpose is to reduce traffic congestion and environmental effect.*

Keywords*: logistics system, city terminal, night delivery.*

1. INTRODUCTION

The evolution of urban areas caused changes of both forms and physical components of goods procurement, storage and distribution. By spatial city spreading, transport infrastructure development and urban land price increase, the macro distribution flow ending is moving towards peripheral areas, in cargo terminals and warehouses dislocated to the urban fringe. Logistics service providers and customers do not wait for precise planning documents, but they solve location-related and logistics system construction problems by themselves in accordance with their abilities and requests. These systems are being dislocated in a quite disorganized manner, without possibility for concentration and consolidation of the flows they are running (Tadić, 2014; Tadić et al., 2014a). Distancing logistics from urban areas has reinforced the adverse effects of logistics flow realization within a city. The number of commercial vehicles serving urban areas is increasing, but there is also an increase in freight vehicle-kilometres and in all adverse impacts on the environment and the quality of life in a city. In order to stop these trends and increase the efficiency of logistics activities, the different initiatives and conceptions of city logistics are defined and analysed. This paper presents the causes and possibilities to return logistics into urban areas. Furthermore, it also presents the advantages, disadvantages and modalities of night delivery as one of the initiative for solving urban distribution problem.

2. REASONS FOR MOVING THE LOGISTICS OUT FROM URBAN CENTERS

Logistics is very important for city development and residents' life and it also presents the significant source of workplaces (Christopherson & Belzer, 2009; Diziain et al., 2012). Large logistics systems supplying national and international market have become a key element of

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urban economics (Christopherson & Belzer, 2009) and tend to be concentrated in large urban areas (Cidell, 2010). High land price is one of the reasons to distance logistics from urban areas. Moreover, road freight vehicles and vans pollute the air, make a noise and visually impair the environment, so there is even less space for logistics in city hearts, resulting in its dislocating to other locations (Deblanc & Rakotonarivo, 2010). This relocation is called unplanned logistics expansion and it represents the global phenomenon (Cidell, 2010; Woudsma et al., 2008).

The logistics expansion has serious consequences for the environment. Dislocating logistics to peripheral urban areas increases the distances that need to be overcome by using road transport modes, the number of kilometers made by freight vehicles, implying additional harmful gases emissions, increasing highway congestion and additional cost for a community. As the road congestion is increasing, logistics providers and carriers show more interest in locations distanced from the city core (Diziain et al., 2012). When it comes to the goods delivery within a city, it is obvious that road transport doesn't have a competitive alternative compared to the other transport modes because of its price, flexibility and very dense network. Limiting road transport volume increase by public authorities could mitigate its environmental effect, but this requires defining of rail or fluvial transport solution.

The thing which should be emphasised is the reduction of road transport use for "last mile" delivery and logistics expansion suppression. In order to achieve that, it is necessary to develop multimodal technologies, both on periphery and within a city (Diziain et al., 2012). The goal is to enable the good connection of urban distribution centres, city terminals and logistics centres at urban fringe by dense transport network. Ideally, they should be connected by waterways or railway. Without these connections, the logistics would be able to return to the cities only in forms of smaller facilities which could be incorporated into small spaces (Diziain et al., 2012). Cargo tramway implementation, as a link between a city terminal and logistics centre at another location within a city, is a concept tested in many European cities (Tadić, 2014; Tadić et al., 2014a). The goods distribution from the city terminal to the generator in the gravitational area could be performed by alternative electric vehicles in order to mitigate the adverse environmental effect (Munuzuri et al., 2005; Russo & Comi, 2012; Tadić, 2014; Tadić et al., 2014a; Tadić et al., 2014b).

Due to their low status and bad image, the logistics companies cannot afford an expensive land, compared to ones who buy it with the residential or commercial purpose. However, various authors (e.g., Diziain et al., 2012; Zečević, 2006) have investigated the justification of building modern and efficient city terminals - multi-storey facilities ("logistics hotels") – representing very attractive solutions and occupying significantly less space. The systems increase the construction costs to a large extent because of technical elements such as strengthened walls or floors, which must withstand high loads. In addition, it must pay attention to architectural and technical construction requirements defined by local authorities. Designing of such a hotel requires facing with noise and other disturbances incurred by logistics activities' realization, but it also requires the architectural effort such as this in office or residential facility construction. Another aspect that cannot be ignored is careful introduction of logistics activities into urban environments, where besides good building design it is necessary to ensure a minimum of interruptions when transporting the goods, especially in road transport (Diziain et al., 2012).

3. NIGHT DELIVERY

The night delivery concept is one of the city logistics initiatives. In order to reduce freight transport in peak hours during a day, the concept suggests the goods delivery during night hours, most commonly in period 10:00 p.m. - 7:00 a.m. This means shifting logistics activities from peak to night hours, when most city activities are reduced to the minimum, thus avoiding traffic jams and reducing congestion on the streets caused by freight transport during a day.

The idea of freight transport realization during off-peak hours emerged long before the night delivery concept implementation. The first data on the night delivery implementation were recorded in the time of Julius Cesar, who prohibited deliveries during a day (Dessau, 1892). Nowadays the solution is implemented in cities around the world (Holguín-Veras, 2008; Niches, 2009).

3.1 Night delivery advantages

The night delivery concept implementation could provide a numerous advantages for all participants in logistics activities and for the city itself. These advantages could also be perceived on global level, in terms of environmental effect and sustainable development. Since the goods delivery is performed at night, when the roads are empty, the higher transport speed could be achieved, thus decreasing the total delivery time and eliminating delivery delays. This contributes to the quality of service improvement; therefore the service providers achieve higher market competitiveness. Also, shifting transport activities into off-peak hours leads to traffic congestion reduction during a day, allowing better quality of life in the city. Another advantage is reflected in the fact that, instead of greater number of vehicles during a day, the smaller number of vehicles during a night is used for facility supply, i.e. there is a reduction in harmful gases emissions and energy consumption. All these improve the logistic systems efficiency and allow the implementation of more efficient strategies and conceptions, especially in the domain of vehicle routing and labour force scheduling, but also in the case of shipment consolidation and grouping. Road safety is improved by congestion and overall transport reduction (Holguín-Veras et al., 2014; Niches, 2009).

From the point of logistics flow generators, the advantages of night delivery include lower distribution costs (although the initial investments in lower-noise equipment are emerging) and higher reliability of a delivery. Higher reliability and quality of service contribute to greater confidence in suppliers and better cooperation of facility and its customers as well, because there is no customer disturbance due to daily goods delivery while desired products are available in early morning hours. The citizens could benefit from more efficient traffic flows, lower traffic congestion in the city centre and lower harmful gases emissions. From the point of the city, it could lead to economic and business development due to the lower delivery costs (Niches, 2009). The studies show that night delivery conceptions could be more efficient from the aspect of environmental externalities from the policy based on fleet renewal (Filippi et al., 2010) or restrictive local government' measures (Comi et al., 2011).

3.2 Night delivery disadvantages

Besides the numerous advantages, the night delivery implies some disadvantages. Although it is reasonably to consider that night delivery results in the reduction of harmful gases emissions, thus reducing the adverse environmental effect, the exploration of this concept found the opposite. Namely, if we take into account freight vehicle speed and climate conditions, it could be concluded that off-peak traffic, regardless the reduction of total harmful gases emission, could have an adverse environmental effect depending on two mentioned factors. The negative effect is more prominent in central than in peripheral urban area because of greater temperature variations, leading to greater shares of pollutants in the air. This disadvantage could be avoided if the freight transport is realized in specific time periods during a night, thus reducing the adverse effects of harmful gases. Also, the effects are more prominent at higher freight vehicle speeds (Sathaye et al., 2010).

In night delivery concept there is a greater variety of participants having different roles and each of them tends to achieve a greater benefits and profit by solution implementation. On the one hand, it can be observed the logistics service providers, which could experience the night delivery advantages on the fastest way due to the reduction of total delivery costs, faster activity

performing, parking costs elimination etc. Naturally, all this directly influence both a consignee and his/her costs. Nevertheless, the consignees are less willing to accept night deliveries and the reasons involve increased risks and criminal exposure of both staff and goods. Furthermore, by transition to night deliveries the consignees expect the increase in operating costs, equipment costs and salaries (Holguín-Veras, 2008). They have a task to provide either staff that will receive the delivery or some facilities for goods storage that go along with a protective system. While providers have savings in business, the consignees might face the increased operating costs arising from additional auxiliary facility costs, overtime costs of employees and higher price of night work. This situation, where one part has more benefits compared to other one, is popularly called BoS (*Battle of Sexes*). Therefore, it is necessary to balance between service bearer and customer and adjust the concept in some way to the consignees, which in this case still have higher expenses than earnings (Holguín-Veras et al., 2012; Niches, 2009).

From the point of population, the problem of the night delivery is the disturbance caused by noise and delivery vehicle lights, thus decreasing the quality of life in the city. This problem could be influenced by using special vehicles and equipment. The emphasis is put on the use of low-noise or electric vehicles, infrastructure improvement and other technical solutions aiming to reduce the noise. Although these solutions have double positive effect – reduce the urban noise and are more ecological solutions – they require large investments which might be a problem (Holguín-Veras et al., 2012; Niches, 2009). In addition, the night delivery concept is less acceptable solution in cities with higher crime rate.

3.3 The types of night delivery

According to the mode of the acceptance of goods, two main types of night delivery could be distinguished: SOHD (*Staffed Off-Hours Delivery*), implying additional staff engagement for the shipment acceptance, and UOHD (*Unassisted Off-Hours Delivery*), with no staff for assistance when accepting the goods. The first principle requires additional cost of labour and night work, but it is a safe option, while second principle may be less safe. The operating costs and risks ratio (Fig. 1) represents the main difference of these two concepts (Holguín-Veras et al., 2012).

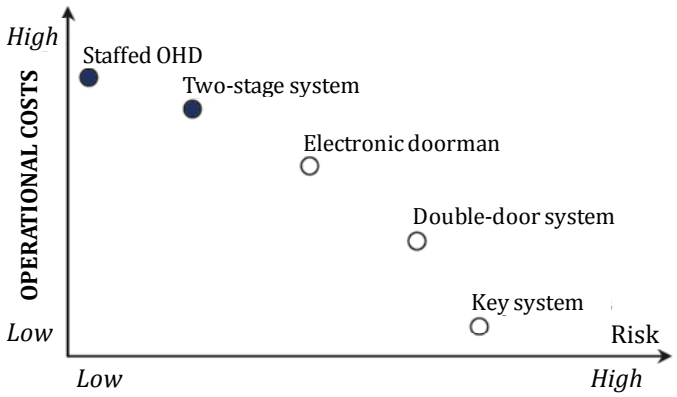

Figure 6. Comparison of UOHD night delivery concept alternatives (Holguín-Veras et al., 2012)

SOHD concept could be found in two variants (Holguín-Veras et al., 2012):

1. Conventional OHD system – one of more members of the staff are present at the site when night delivery is performed;
2. Two-stage system – it is used for supplying large generators and involves two stage, the first one with appropriate delivery room for shipment acceptance and sending, and in the second stage the goods are sent to actual consignees as a part of regular daily transport.

UOHD concept implies more alternatives for acceptance of goods (Holguín-Veras et al., 2012):

1. Double-door system – the driver performing delivery is provided with a key to an outside door that leads to a small storage area, separated from the rest of the business area, so the driver doesn't have a full access to the facility;
2. Key system – the driver is provided with a key which enables him to deposit the goods at a specific location;
3. Electronic key system – the driver is provided a password or security code, defined by facility owner, to access the facility or the storage box;
4. System with manual/electronic key and security cameras – the principle is the same as in previous case, except the installation of monitoring cameras;
5. Electronic doorman system – a remote operator, assisted by security cameras and radio/phone, grants access to the facility and requires identification checks.

4. CONCLUSIONS

Severe road congestion and land price are the main reasons for dislocating logistics systems in peripheral areas of the city. From the other hand, the return of logistics system into the cities requires facing the noise and other disturbances arising from logistics operations. The main problem is the road transport which attracts a special attention due to its dominant role in traffic flows and negative effects that implies. This problem has initiated the development and the use of other transport modes, especially intermodal transport solution of city logistics.

In order to solve the problem of goods distribution in urban areas, the night delivery concepts are analysed. The deliveries during peak hours are ineffective, unpredictable and imply increased fuel consumption (Vilain & Wolfrom, 2001). From the other hand, the night deliveries are faster, more reliable and do not require the change of vehicles, thus reducing delays and improving the efficiency. By analysing the problem of night delivery concept implementation it can be concluded that the efficient transport-distribution system cannot be achieved without a joint action of all participants. It is necessary that all city logistics participants cooperate closely to make the system function efficiently (Tadić, 2014).

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