REGIONAL APPROACH TO URBAN CONSOLIDATION CENTRE IMPLEMENTATION FOR SMALL CITIES

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Abstract

Economic growth at urban area is connected with the increase of industrial production and trade turnover. It implicates the need of controlling the growing chaos of goods flow especially at the urban area. City freight delivering problems are caused by narrow streets on the one hand and still increasing number of cars, passenger of public transport and pedestrians on the other hand. Due to increasing demands of the recipients a lot of unwanted results (like congestion, escalation of waste and environmental devastation, increased noise level, greater than before risk of car accidents) are generated by freight transporting subsystem of the city.

Very interesting alternative for traditional freight delivery are Urban Consolidation Centers, where products are transported from suppliers by large trucks directly to UCC, next all parcels are sorted and forwarded in consolidated form to receivers.

Keywords

Freight delivering, city logistics, Urban Consolidation Center, logistics net, supply chains

INTRODUCTION

A lot of problems occurring in the city, out of which some are related to city freight delivering, find their solution due to the development of city logistic management. Effective management of freight delivering at the urban area is very important for the growth of safety and it influence on limiting of negative effects of functioning transport city-subsystem in the city environment. Reduction of noise and transport pollution appears especially important on the territory of spa and tourist resorts with shops, hotels, restaurants located in their centres as well as pedestrian areas and

promenades which become excessively loaded due to constant deliveries. Interesting alternative for traditional freight delivering is an idea of Urban Consolidation Centers.

IDEA OF URBAN CONSOLIDATION CENTER

The concept of Urban Consolidation Centres goes back to 1970-es when the first publications devoted to the problem of deliveries to urban areas appeared. The oldest and still functioning solution of that type has been the Urban Consolidation Centre in Tenjin I Japan (its realization was started in 1978). In the recent years in Europe there has been noticed special interest concerning the development of Urban Consolidation Centres. Most projects of that type have been implemented in many countries. In Germany UCC were implemented among others in Aachen, Potsdam-Berlin, Bremen, Cologne, Essen, Frankfurt, Freiburg, Kassel, Nuremburg, Regensburg, Stuttgart, Ulm. Such consolidation centres develop with growing dynamics also in Great Britain, Holland and Italy.

So far in Poland there have not existed any implementation projects concerning Urban Consolidation Centres. The reason for such situation is, on the one hand, relatively low awareness of needs referring to applying solutions of urban logistics and, on the other hand, the lack of understanding the issue of UCC and their significance for effective realization of urban deliveries. Other barriers appear to be the lack of legal regulations and resulting from them organizational difficulties.

Urban Consolidation Centre is defined as „(…) logistic base located in the vicinity of the place of performing services (e.g. city centres, whole cities or specific locations like shopping malls) where numerous enterprisers deliver goods destined for the serviced area from which consolidated deliveries as well as additional logistic and retailed services are realized" [2]. The major task of Urban Consolidation Centre is the reduction of traffic in the city centre with maintaining the same level of deliveries.

Freight delivery without utilizing of UCC is based on direct connections between all suppliers and purchasers – every delivery is realized independently (fig.

1a), therefore it generates negative results for the city environment due to increased amount of large-size trucks [6].
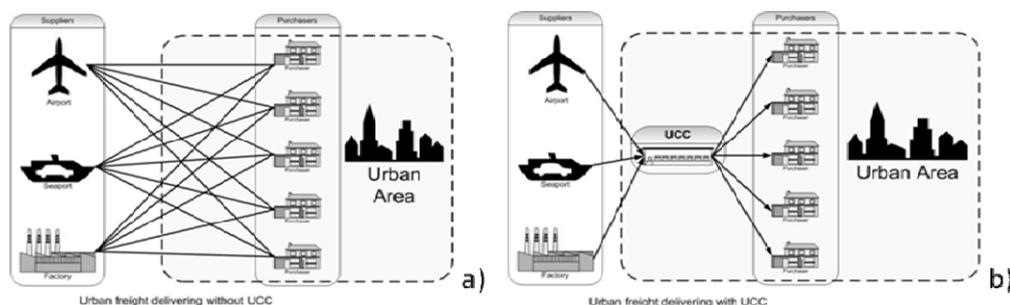

Fig. 1. Urban freight delivering: a) without UCC; b) with UCC
Source: [6]

Urban Consolidation Centre allows to eliminate these problems. In this case products are transported from suppliers by large trucks directly to UCC, in next step all parcels are sorted and forwarded in consolidated form to receivers (fig. 1b) [6].

REGIONAL APPROACH FOR UCC DEVELOPMENT BASED ON WESTPOMERANIAN REGION EXAMPLE

Westpomeranian Region is placed in west-north part of Poland at the Baltic Sea coast. This region combines the commercial role with the role of a popular touristic and spa attraction. At the area of Westpomeranian Region there are four seaports: Szczecin, Świnoujście, Kołobrzeg and Darłowo. Two of them – Szczecin and Świnoujście – function together as an integrated system, managed by Szczecin-Świnoujście Seaport Authority. Both ports realize the most important functions for delivering system in this part of Poland.

This region is visited because of high tourist and spa values. A lot of tourist attractions of Westpomeranian Region, like clean rivers and lakes, forests as well as the coast line of the Baltic Sea, have contributed to the development of the health resorts (Świnoujście, Międzyzdroje, Kołobrzeg, Połczyn Zdrój, Dźwirzyno) [9].

Table 1. The comparison of the number of inhabitants to the number of tourists in the major seaside resorts of the Westpomeranian Voivodeship

Seaside resort	Approximate number of inhabitants (x 1,000)	Approximate number of tourists (x 1,000)
Darłowo	14	40
Dziwnów	2	93
Kołobrzeg	44	363
Mielno	2	117
Międzyzdroje	5	108
Rewal	1	142
Świnoujście	40	159
Trzebiatów	10	33
Ustronie Morskie	2	61

Source: own work

During summer in some towns the number of people significantly increases. The biggest growth of people can be noticed in Międzyzdroje and Mielno (these small towns become willingly visited resorts and in tourist high season the number of people increases even 24 times) [11]. In Kołobrzeg, Świnoujście and Darłowo the growth reaches respectively 443%, 273%, and 248% [11]. The tab. 1 illustrated the comparison of inhabitants' number to the tourists' number in major seaside resorts in Westpomeranian Voivodeship.

By the reason of that Westpomeranian Region is very interesting area for analysis of the regional approach for development of Urban Consolidation Centres. Based on survey, which was carried out on a cyclical basis in the period from May 2009 to December 2010 [7] it's possible to divide major touristic cities of Westpomeranian Region into two groups, where all analysed cities use as the major supply source one of the biggest city in the region – Szczecin or Koszalin (fig. 2). The size of the seaside resorts and the explicit seasonality of deliveries determines utilization of system of two UCC. Both consolidation centres should be subregional (their task will be serving one big town Świnoujście or Kołobrzeg and a few smaller resorts).

Fig. 2. The location of the analysed seaside resorts and their main sources of supply
Source: own work

The basic goal of UCC implementation is limiting the congestion effect which is observed mainly on the main access roads to the seaside resorts and in their vicinity. Due to the location of wholesalers on the area of UCC the flow of goods as well as the use of delivery vehicles becomes more efficient with the transport routes significantly shortened. In case of designing a consolidation centre meant for offering services to the local tourist and health resorts their specificity and adjusting solutions to the service market demands need to be focused upon. Thus, UCC here shall have trade character and as far as its structure is concerned it should be adjusted to this type of demands.

The fundamental problem is the proper location of the consolidation centre, which would make it possible to make full use of its possibilities and to achieve the goals. One of the most popular and useful methods for logistics nodes location is the centre-of-gravity method. The method is based on the following formula:

$$C_{x,y} = \frac{\sum_{i=1}^{I} r_i e_i d_i + \sum_{j=1}^{J} R_j E_j S_j}{\sum_{i=1}^{I} r_i d_i + \sum_{j=1}^{J} R_j S_j},$$

where

$\quad\quad C_{x,y}$ — centre of gravity with x- and y-coordinates;

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r_i – transportation rate for goods transported between transit node and purchaser i;

R_j – transportation rate for goods transported between supplier j and transit node;

e_i – euclidean distance between transit node and purchaser i;

E_j – euclidean distance between supplier j and transit node;

d_i – weight volume of demand of purchaser i;

S_j – weight volume of supply of supplier j;

I – number of purchasers;

J   – number of suppliers.

The number of possible locations of node is expressed as [6]:

$$\frac{\left(x_{max} \cdot y_{max}\right)!}{\left(\left(x_{max} \cdot y_{max}\right) - n\right)!},$$

where:

x_{max} – maximum value of x-coordinate in the set of values defining localization coordinates of purchaser;

y_{max} – maximum value of y-coordinate in the set of values defining localization coordinates of purchaser;
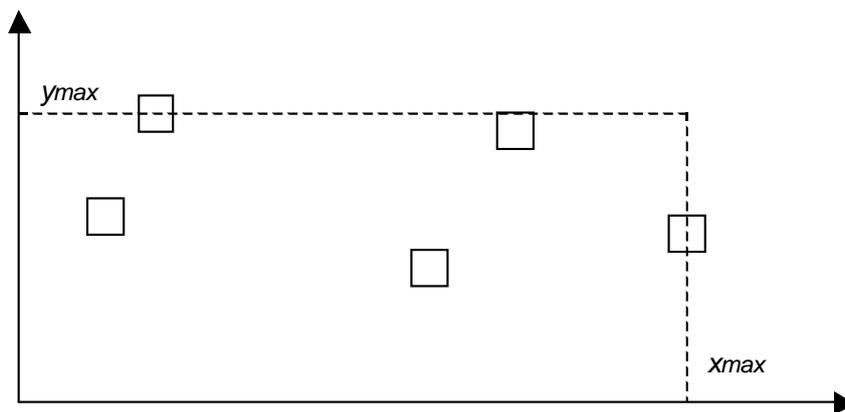
n – number of transit nodes.

Fig. 3. Values x_{max} and y_{max} in a system of coordinates
Source: [6]

For the above problem it is necessary to plan such a localization of transit nodes and such connections of purchasers with individual transit nodes, to achieve possibly lowest costs of delivery. These costs will, in turn, be correlated with distances between individual network nodes, and therefore, the minimizing of those distances will also in effect minimize the total cost of transport, or the cost of transport of one freight unit (e.g. ton) per one unit of distance (e.g. kilometer). In view of the above, the optimized element will be expressed as sum of Euclidean distances between network nodes:

$$\sum_{i=1}^{I} e_i + \sum_{n=1}^{N} E_n \rightarrow \min,$$

where:

e_i – Euclidean distance between i-th purchaser and connected transit node;

E_n – Euclidean distance between n-th transit node and supplier.

Based on above conditions and data analysis, the area was divided into two subareas presented in fig. 4. In the end, the following optimal locations for the consolidation centres were proposed:

• for the UCC which is to serve Świnoujście, Międzyzdroje, Dziwnów, Rewal and - outside the summer season – Trzebiatów, the optimal location is the area at the intersection 84 kilometres from Szczecin (Fig 4a);
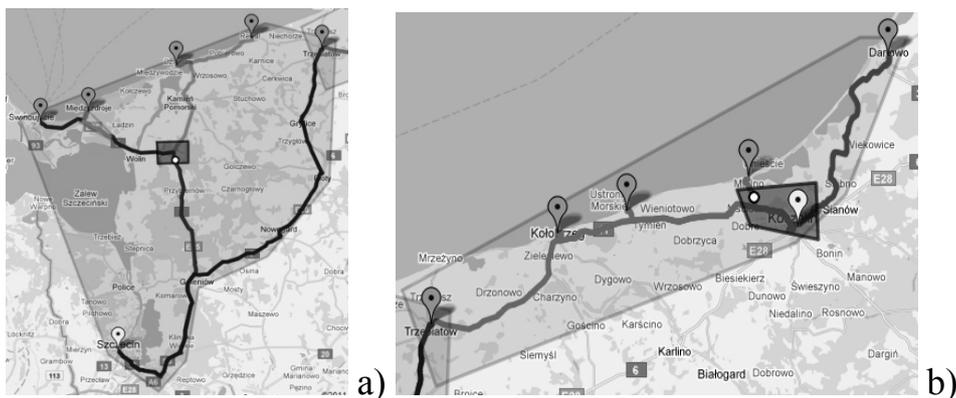

Fig. 4. UCC localizations: a) – with the main sources of supply in Szczecin,
b) – with the main sources of supply in Koszalin
Source: own work

- for the UCC which is to serve Kołobrzeg, Mielno, Ustronie Morskie, Darłowo and - in the summer season - Trzebiatów, the favourable location seems to be the area located close to the supply source itself – Koszalin (Fig. 4b).

The proposed locations result directly from the analysis of the transport routes and the volumes of deliveries made to the individual seaside resorts.

The presented concept of consolidation centres appears to be very simple – get the order, accept it and send to the right wholesaler, sort out goods according to a recipient's demand, hand them over to the transport subsystem and deliver to receiver in consolidation form. However, with the large number of goods it turns out to be much difficult.

SUMMARY

In this paper the author presented the regional approach to idea of Urban Consolidation Centre, based on tourist and health resort of Westpomeranian Region. Applying of UCC seems to be a good solution enabling more effective functioning of tourist, recreational and health resort services and, what seems especially important, the improvement of the services quality due to reducing the noise and pollution in the tourist zone as well as limiting the traffic of the over-gauge vehicles and the decrease for parking area in the delivery zone.

At this moment the idea of Urban Consolidation Center is new in Poland. The reason for this, on the one hand, is the relatively low awareness of the needs to apply urban logistics solutions, and, on the other hand, failure to understand the idea of UCC and its significance for urban deliveries effectiveness.

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