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Technical and organizational assumptions of applying UCCs to optimize freight deliveries in the seaside tourist resorts of West Pomeranian Region of Poland

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Abstract

The West Pomeranian Province is located at the Baltic Sea coast in the west-north of Poland. This region combines the commercial role with the tourist and spa functions. Several tourist attractions of the West Pomeranian Province like clean rivers and lakes (6\% of the area), forests (mainly pine forests occupying 34.5\% of the area) as well as the northern border which is the Baltic Sea coastline (184.9 km) have contributed to the development of the health resorts (Świnoujście, Kołobrzeg, Połczyn Zdroj), as well as recreational tourism (the seaside and lake resorts). The counties (poviats) located on the coast generate almost 65\% of the entire tourist traffic in the region. Effective organization of freight deliveries in the areas of seaside tourist resorts is of particular importance for the efficient functioning of the entire region. This paper focuses on the assumptions for implementing a delivery system based on using two UCCs to serve their linked resorts. The authors have applied the standardized interview method for the analysis of the tourist traffic impact on delivery volumes in the selected area, and the centre-of-gravity method for locating the UCCs.

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Keywords: Urban consolidation center; seaside resorts; spa resorts; sources of supply; West Pomeranian Region of Poland
1. Introduction

Geographically (the southern coast of the Baltic Sea), the tourism industry of the West Pomeranian Province is predominantly based on seaside resorts. The counties (poviats) located on the coast generate almost 65% of the entire tourist traffic in the region, while 20% of the tourists visit Szczecin — the region’s capital city, and only 15% are those visiting other counties. Resorts like Świnoujście or Kołobrzeg, despite being medium-sized towns (from the Polish perspective), experience a considerable increase in their populations in the periods of intensified tourist traffic (May to September). In 2009, more than 290,000 of tourists spent their holidays in Kołobrzeg, which has a population of less than 50,000 (Wasilewska and Klimaszewska, 2010). The number of tourists in Świnoujście reached almost 120,000 while the town’s population does not exceed 40,000 (Wasilewska and Klimaszewska, 2010). This is even more apparent in small resorts such as Międzyzdroje or Darłowo. The majority of tourism businesses (hotels, shops, restaurants, bars) are SMEs. However, their supplies are delivered chiefly by suppliers located out of town. Moreover, tourist and health services in these towns interpenetrate with marine economy (activity of commercial and fishing harbours).

In view of the above, effective organization of freight deliveries in the areas of seaside tourist resorts is of particular importance for the efficient functioning of the entire region, both in terms of the transport process itself and in view of proper implementation of the region’s tourism functions.

This paper continues the research presented in the paper titled ‘Idea of Urban Consolidation Centers for Medium-Size Touristic Cities of the West Pomeranian Region of Poland’ (the Sixth International Conference on City Logistics in Puerto Vallarta, Mexico). The previous study set forth the concept of using UCCs to improve the efficiency of deliveries in the above-mentioned resorts, it also discussed some preliminary assumptions for the functional structure and presented a general data flow diagram for the proposed UCC type. This paper in turn focuses on the proposal to implement a delivery system based on two UCCs to serve their linked resorts. It has to be stressed that because of the character and size of Polish tourist resorts, the issue of developing UCCs must be viewed in the regional context. In the proposed solution the UCC is not to serve a single town only. The main assumption of the concept is to link each of the centres to one major city and several neighbouring smaller towns.

2. The analysis of the tourist traffic impact on delivery volumes in selected seaside resorts in the West Pomeranian Province

The growing number of town users leads to an increase in demand for freight transport — of raw materials, semi-finished products, finished products, as well as of industrial and municipal waste. The majority of transport in urbanised areas is generated by industrial, commercial and service companies. The distribution function initiated by the enterprises contributes to an increase in logistic flow streams within a limited area, including, but not limited to:

- transporting cargoes from outside to the urbanized area,
- transporting cargoes produced in the urbanized areas away to the surrounding areas,
- transport within the urbanized area,
- transit transport.

The West Pomeranian Province is a particularly interesting region when it comes to researching the issues of freight transport to urbanized areas. Due to its specific nature, and in particular the interweaving of the marine economy (trading and fishing ports) and the tourist and spa services sector, the vital problem is adequately effective organisation of deliveries in the seaside holiday and spa resorts.
On the basis of data supplied by the Central Statistical Office for the years 2004 – 2009 (Wasilewska and Francuzowicz, 2006; Wasilewska and Klimaszewska, 2010), the region’s seven key holiday resorts were selected – these are the ones that generate the greatest increase in the number of tourists arriving in the summer season: Darłowo, Dziwnów, Mielno, Międzyzdroje, Rewal, Trzebiatów, Ustronie Morskie. Additionally, the research also included the two towns that combine the tourist and spa functions: Kolobrzeg and Świnoujście.

2.1. An increase in the number of people staying in the seaside resorts included in the research

During the tourist season (from May through September) the medium-sized towns such as Świnoujście or Kolobrzeg experience such a considerable influx of tourists that the number of people staying in those towns may be even several times bigger than in winter season. It is even more perceptible in small seaside resorts such as Międzyzdroje or Darłowo. Table 1 presents the relationship between the number of permanent inhabitants of the region’s major holiday resorts and the number of tourists visiting those places. The estimated figures are based on the Central Statistical Office data as well as the materials available in the Public Information Bulletins for the said resorts.

Table 1. The comparison of the number of inhabitants to the number of tourists in the major seaside resorts of the West Pomeranian Province in 2010 (Source: Own work)

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

The greatest increase in the number of people staying at a given seaside resort can be observed in Mielno and Rewal. These are rather small villages, but due to their favourable location and offered facilities they attract many tourists. Therefore, the number of guests staying there during summer season outnumbered the village population even 32-fold, whereas in Kolobrzeg, Świnoujście and Darłowo the increase amounts to respectively 824%, 398% and 286%!

A considerable part of the hospitality services (hotels, shops, restaurants, bars) is provided by micro and small enterprises. Table 2 presents the number of service outlets which operate in summer season. Ca. 15% of the outlets listed below operate in the holiday resorts throughout the year. The only exceptions are the towns of Kołobrzeg and Świnoujście, where only 18% service outlets close for winter season, which is due to their spa status.
Table 2. The comparison of the number of inhabitants to the number of tourists in the major seaside resorts of the West Pomeranian Province in 2010 (Source: Own work)

<table>
<thead>
<tr>
<th>Seaside resort</th>
<th>Public accommodation facilities</th>
<th>Public catering facilities</th>
<th>Shops</th>
<th>Souvenir stalls</th>
<th>Grocery stalls</th>
</tr>
</thead>
<tbody>
<tr>
<td>Darłowo</td>
<td>59</td>
<td>51</td>
<td>61</td>
<td>48</td>
<td>30</td>
</tr>
<tr>
<td>Dziwnów</td>
<td>60</td>
<td>40</td>
<td>31</td>
<td>58</td>
<td>39</td>
</tr>
<tr>
<td>Kołobrzeg</td>
<td>131</td>
<td>163</td>
<td>175</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>Mielno</td>
<td>63</td>
<td>66</td>
<td>24</td>
<td>22</td>
<td>9</td>
</tr>
<tr>
<td>Międzyzdroje</td>
<td>196</td>
<td>77</td>
<td>65</td>
<td>62</td>
<td>53</td>
</tr>
<tr>
<td>Rewal</td>
<td>53</td>
<td>70</td>
<td>30</td>
<td>46</td>
<td>33</td>
</tr>
<tr>
<td>Świnoujście</td>
<td>144</td>
<td>170</td>
<td>168</td>
<td>29</td>
<td>22</td>
</tr>
<tr>
<td>Trzebiatów</td>
<td>21</td>
<td>67</td>
<td>48</td>
<td>37</td>
<td>26</td>
</tr>
<tr>
<td>Ustronie Morskie</td>
<td>36</td>
<td>48</td>
<td>46</td>
<td>75</td>
<td>55</td>
</tr>
</tbody>
</table>

2.2. Volume of deliveries made in the analyzed seaside resorts in correlation with providing tourist services – assumptions and analysis method

In order to describe the supply process of the aforementioned facilities, it is necessary to divide the analysed seaside resorts into two groups. The first group includes the seaside resorts which experience intensive tourist traffic only in the summer season (i.e. from end of May till end of September). These include Darłowo, Dziwnów, Mielno, Międzyzdroje, Rewal, Trzebiatów, Ustronie Morskie. The second group includes the towns of Kołobrzeg and Świnoujście, where due to their spa status visitors arrive also outside the summer season, though undoubtedly their number is then significantly smaller.

For the purposes of analysing the deliveries performed within the seaside resorts in question, the standardized interview method was applied. The research was carried out on a cyclical basis in the period from May 2009 to December 2010 and included:

- 92% of public accommodation facilities, including: 125 hotels, 100 campsites, 28 motels, 73 lodging houses, 328 private apartments, 5 youth hostels, 38 spa resorts, 4 agrotourism hotels;
- 95% of public catering facilities, including: 107 restaurants, 202 pubs, 118 fast food outlets, 111 cafes, 123 fish and chips shops, 56 discotheques;
- 87% shops and stalls, including: 164 general stores, 18 wholesalers, 300 clothes and shoe shops, 11 shopping centres, 31 household appliance shops, 32 bakeries and cake shops, 392 souvenir stalls, 271 grocery stalls, 136 small general stores.

2.3. Volume of deliveries made in the analyzed seaside resorts in correlation with providing tourist services – The averaged results of the survey

The grocery shops and general stores purchase their supplies mainly in Szczecin (on average 87% of deliveries) and in Koszalin (on average 89% of deliveries). During the tourist season 85% of the respondents replenish their stocks on a daily basis, whereas the remaining 15% do this more often than 3 times a week. Outside the season, the frequency of deliveries decreases to once or twice a week (respectively 56% and 29% of the respondents). Own transport is used by 76% of the respondents, whereas 69% of them also avail themselves of the suppliers’ transport (especially with regard to deliveries of beverages and frozen foods). When it comes to those two commodity groups, 92% of the
respondents admit they use only the suppliers’ transport, whereas ca. 78% make use of mixed (own) transport in the case of unexpected shortages resulting from increased sales. Only deliveries of bakery products are made by own transport from the local area. Non-food products are usually (in 92% of cases) delivered to the seaside resorts from the nearest city (Szczecin or Koszalin) mainly by the suppliers’ transport and mostly twice a week.

Hotels and restaurants receive deliveries of groceries on a daily basis using the suppliers’ and mixed transport (51% on average), while the remaining respondents use own transport (43%), out of which 37% only sporadically avail themselves of transport other than their own. Beverages and frozen foods (ca. 68%) are delivered by the supplier’s transport, similarly as bakery products (97%). The aforementioned commodity groups are delivered daily during the tourist season, and in peak sales periods even twice a day, whereas in 96% of cases replenishing the goods assortment is done by means of own transport. Outside the season, the frequency of grocery goods deliveries drops to once or twice a week, except for bakery goods that are delivered on a daily basis. Non-food products are delivered once a week, and in 98% of the entities this is done by means of the suppliers’ transport.

In the case of production and service enterprises, ca. 80% of their raw materials suppliers are located within the distance of 40 – 150 km, and the transport is performed mainly by the suppliers. Deliveries from suppliers located within the same village/town in 75% are performed by own transport.

Deliveries to grocery stalls are in ca. 83% made daily by means of own transport. Souvenir stalls also get their supplies mainly by own transport, and this is done ca. 3 times a week in the peak tourist season.

Delivery organization is similar in the case of Kołobrzeg and Świnoujście. In Kołobrzeg, grocery shops and general stores purchase the groceries mainly in Koszalin (ca. 53% of the respondents), whereas 73% of the respondents from Świnoujście declare they buy their groceries in Szczecin. In both towns ca. 56% of deliveries are performed by means of own transport (except for bakery goods, beverages and frozen foods). Bakery products in more than 90% of the cases are delivered from within the same area (from local producers), mainly by the baker’s transport, and own transport is used only to replenish any shortages. Beverages and frozen foods are delivered by the suppliers’ transport in 79%, and, similarly as in the case of bakery goods, own transport is used to replenish any shortages. The deliveries frequency during the tourist season and outside it are presented in Table 3.

Non-food products are usually (in 92% of cases) delivered to the seaside resorts from the nearest city (i.e. Szczecin or Koszalin) mainly by the suppliers’ transport, and mostly twice a week.

Hotels and restaurants declare that their groceries are delivered daily (on average 49%), using the suppliers’ or mixed transport. Beverages and frozen foods (ca. 81%) are delivered by the suppliers’ transport, similarly as bakery products (86%). The aforementioned commodity groups are delivered daily during the tourist season, and in peak sales periods even twice a day, whereas in 46% of cases replenishing the goods assortment is done by means of own transport. Outside the tourist season the frequency of groceries deliveries drops to one or two deliveries a week, except for bakery products which are supplied every day. Non-food products are delivered once a week, in 96% by the suppliers’ transport in the case of these entities.

When it comes to production and service enterprises, raw material supplies from outside the town/village area are made mainly by the suppliers’ transport (ca. 84%), whereas raw material supplies from places within the distance of up to 30 km are usually made by own transport (ca. 88%).

Deliveries to grocery stalls are in 69% performed daily by means of own transport. Souvenir stalls also get their supplies mainly using own transport, and this is done 3 times a week or even more in the peak tourist season.
Table 3. Frequency of grocery goods deliveries in Świnoujście and Kolobrzeg (Source: Own work)

<table>
<thead>
<tr>
<th>Frequency of deliveries</th>
<th>Świnoujście</th>
<th>Kolobrzeg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>in season</td>
<td>outside season</td>
</tr>
<tr>
<td>once a week</td>
<td>---</td>
<td>32%</td>
</tr>
<tr>
<td>twice a week</td>
<td>---</td>
<td>52%</td>
</tr>
<tr>
<td>3 and more times a week</td>
<td>35%</td>
<td>16%</td>
</tr>
<tr>
<td>daily</td>
<td>65%</td>
<td>66%</td>
</tr>
</tbody>
</table>

Trzebiatów, as the only one among the towns and villages included in the research, receives its supplies from both Szczecin and Koszalin (Table 4). Therefore, it may be stated that Trzebiatów lies on the borderline between the two catchment areas served by respective supply sources. It is therefore important for our further considerations to resolve the question of assigning this town to a specific consolidation centre.

Table 4. Sources of supply for Trzebiatów (Source: Own work)

<table>
<thead>
<tr>
<th>Service outlet type</th>
<th>Szczecin</th>
<th>Koszalin</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shops</td>
<td>47%</td>
<td>39%</td>
<td>14%</td>
</tr>
<tr>
<td>Hotels</td>
<td>31%</td>
<td>45%</td>
<td>24%</td>
</tr>
<tr>
<td>Restaurants</td>
<td>26%</td>
<td>59%</td>
<td>15%</td>
</tr>
<tr>
<td>Stalls</td>
<td>29%</td>
<td>59%</td>
<td>12%</td>
</tr>
<tr>
<td>Delivery average</td>
<td>33.25%</td>
<td>50.5%</td>
<td>16.25%</td>
</tr>
</tbody>
</table>

Table 5 contains the summary of daily volumes of deliveries made to various hospitality facilities located within the seaside resorts being the subject of the research.

Table 5. Average daily volumes of deliveries made to the discussed seaside resorts in kgs (Source: Own work)

<table>
<thead>
<tr>
<th>Seaside resort</th>
<th>Delivery volume</th>
<th>Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>outside season</td>
<td>in season</td>
</tr>
<tr>
<td>Darłowo</td>
<td>5587</td>
<td>13867</td>
</tr>
<tr>
<td>Dziwnów</td>
<td>467</td>
<td>10885</td>
</tr>
<tr>
<td>Kolobrzeg</td>
<td>31859</td>
<td>39948</td>
</tr>
<tr>
<td>Mielno</td>
<td>398</td>
<td>12862</td>
</tr>
<tr>
<td>Międzyzdroje</td>
<td>773</td>
<td>22435</td>
</tr>
<tr>
<td>Rewal</td>
<td>356</td>
<td>11527</td>
</tr>
<tr>
<td>Świnoujście</td>
<td>28964</td>
<td>38867</td>
</tr>
<tr>
<td>Trzebiatów</td>
<td>5554</td>
<td>7745</td>
</tr>
<tr>
<td>Ustronie Morskie</td>
<td>321</td>
<td>10228</td>
</tr>
</tbody>
</table>
The data supplied above illustrate the size of the problem. As the listed seaside resorts do not have any production enterprises, the freight deliveries pertain mainly to the service and trading functions of the businesses operating in those areas. The towns of Świnoujście and Kolobrzeg are some exceptions here, having also the sea port function and consequently playing the role of a transit node. However, it is necessary to emphasise the unique character of Świnoujście which is located on islands and features two distinctly separated functional zones: the right-hand side part of the town (located on the island of Wolin) features mainly the sea port and reloading functions, whereas the left-hand side part (on the island of Uznam) serves residential, spa and tourist functions. The two functional zones practically do not permeate in the town centre.

3. The analysis of the road infrastructure of the West Pomeranian Province in the context of making deliveries to the selected seaside resorts

3.1. The system of road connections in the West Pomeranian Province

Due to its location, the West Pomeranian Province is an important part of Poland’s road communication system. The most significant elements that are decisive for the nature of the region are the two big sea ports in Szczecin and Świnoujście, and the crossborder traffic to/from Germany. The West Pomeranian Province is the main transit route for the transport of goods and passengers in the direction of Copenhagen and Ystad as well as the northern part of Germany. Nevertheless, the region’s road communication system is definitely underdeveloped to meet its needs. Currently the primary road system of the Province mainly consists of public national, regional and district roads of the total length of 11 136.44 km of which 10 307.44 km are hard-surfaced roads. Fig. 1 presents the road system of the West Pomeranian Province. The greatest concentration of the national roads is found in the western part of the Province and around its main cities – Szczecin and Koszalin.

Fig. 1. The map showing the roads in the West Pomeranian Province (Source: General Directorate, 7.12.2009)
The total length of the public roads of the West Pomeranian Province in the years 2004 – 2008 increased by merely 1.61%. While the biggest increase regarded the municipal public roads, it was accompanied by a negligible decrease in the length of interurban public roads (Transport, 2005; Transport, 2006; Transport, 2007; Transport, 2008; Transport, 2009).

3.2. The analysis of the road connections between the analysed seaside resorts and their main sources of supply

Fig. 2 shows a map section which presents the location of the analysed seaside resorts (dark marks) and their main sources of supply – the cities of Szczecin and Koszalin (lighter marks). As already mentioned, the main problem connected with deliveries to the seaside resorts in question is the underdeveloped road system between them and their main supply sources. Analysing the system of road connections as well as the research data regarding delivery volumes and main sources of supplies, it is possible to aggregate the resorts to make 5 groups, within which the individual places are interconnected by a shared traffic route:

- Szczecin – Międzyzdroje – Świnoujście,
- Szczecin – Dziwnów – Rewal,
- Szczecin – Trzebiatów,
- Koszalin – Mielno – Ustronie Morskie – Kołobrzeg – Trzebiatów,
- Koszalin – Darłowó.

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

The best road connection is found between Szczecin, Międzyzdroje and Świnoujście. They are connected by national road No. 3 which constitutes the Polish part of the north-south international route E65 from Malmö in Sweden to Chaniá (Crete, Greece). The road section relevant for our analysis runs from Szczecin through Goleniów, Wolin, Międzyzdroje to Świnoujście. The total length of the route is 113 km, and on average it takes ca. 1h 45 min. to cover the distance. National road No. 3 is planned to be renovated and joined with S3 expressway that links Świnoujście and Lubawka located near the Polish
southern border. Some parts of the road system are being upgraded, which also includes the construction of two ring roads: around the villages of Troszyn, Parlówko and Ostromice, and around the village of Miękowo. These developments are relevant from the point of view of deliveries made to Świnoujście and Międzyzdroje due to the fact that currently all the vehicles transporting goods in those directions have to go through the villages (which lengthens the transport time and decreases the transport safety). It is estimated that when the aforementioned ring roads have been put into use, the travel time will be shorter by 10 – 15 minutes.

The route from Szczecin through Dziwnów to Rewal starts in the same way as the above described (road no. 3) for the first 84 kilometres, but after passing Ostromice it is necessary to enter regional road no. 107, and then in the village of Dziwnówek – regional road no. 102. The total length of the route is 117 km, and the average travel time is ca. 2 hours.

The route Szczecin – Trzebiatów is the same as above up to the 40th kilometre, and then the journey is continued along national road no. 6 which is part of the international route E28 linking the border crossing to Germany (Kołbaskowo) – Szczecin – Goleniów – Koszalin – Słupsk – Gdańsk – Legowo. The road connects the cities of Szczecin and Gdańsk. It is worth noticing that the routes E65 and E28 overlap between Szczecin and Goleniów. From the village of Ploty, the route goes along regional road no. 109. The total length of the route is 114 km, and the journey takes ca. 1h 50 min. An alternative solution is the route running through the town of Kamień Pomorski, which is only 6 km longer, but to a large extent overlaps with the route Szczecin – Dziwnów – Rewal, which is relevant in view of the possibility of consolidating the freights and combining transports.

The route Koszalin – Mielno – Ustronie Morskie – Kołobrzeg – Trzebiatów first runs along national road no. 11, then after 7 kilometres it is necessary to take regional road no. 165 to Mielno, and then regional road no. 102 to Trzebiatów. The total length of the route is 81 km, and on average it takes ca. 1h 35 min. to cover the distance. It is important to note that in the future the section of the national road No. 11 from Kołobrzeg to the junction with A1 motorway and to the connection with S1 expressway will become S11 expressway. This will contribute to improving the road travel conditions and shortening the transport time.

The route Koszalin – Darłowo may be considered quite good. It runs along the aforementioned national road No. 6 (the Polish section of E28), and then from the 32nd kilometre – along national road No. 37. The total length of the route is 47 km, and the journey takes ca. 45 min.

3.3. The main problems connected with the condition of the road system in the discussed area

The technical condition of the roads in the West Pomeranian Province is not very good, and in some places it is even very bad. This is due (but not limited to) to the following factors (Strategy, 2010):

- bad quality and condition of the road surface,
- no ring roads and grade-separated crossings (including two-level junctions) on intensive traffic routes,
- lack of paved shoulders and drainage systems,
- insufficient width of carriageway in many road sections,
- main roads running through built-up areas,
- insufficient number of parking spaces.

The final sections of the above described delivery routes between buyers and main sources of supply are predominantly regional roads (numbered 102, 107, 109, 110 and 165). The parameters and technical condition of the roads often hinder effective performance of transport services in the region, and also compromise the road traffic safety. A significant problem is also the accessibility and servicing the seaside areas, where traffic increases by ca. 80% during the summer season. Immediate repair is
necessary in the case of 31% of the national roads, 14% of the regional roads and ca. 13% of the district roads (Strategy, 2010). Among those are regional roads no. 102, 107 and 165. These are single-carriageway, two-lane, bendy roads, moreover, they run through forest areas. Only the national roads offer better driving conditions, even though they haven’t yet been entirely upgraded to take the form of dual carriageway, two-lane roads. These problems have an impact mainly on:

- compromising the traffic safety in the region,
- hindering the transit transport, including the cross-border traffic,
- limiting the transport accessibility to the sea ports as well as the main industrial centres in the region,
- limiting the accessibility of places with high tourist potential, especially the seaside areas,
- hindering the territorial integration of the region, within the primary settlement network including the regional and subregional centres.

4. The technical and organisational assumptions for the freight delivery system in the seaside resorts applying UCC

4.1. UCC – A solution to support optimisation of delivery performance

The concept of Urban Consolidation Centres dates back to the 1970s that saw the first studies concentrating on the problem of performing deliveries in urbanised areas. The first projects were of purely academic nature and were never implemented. It was not until 1978 that the first solution was put into practice – the Urban Consolidation Centre in Tenjin, Japan, which has been functioning ever since (Brown et al., 2005).

Over the past few years, development of Urban Consolidation Centres has been enjoying some popularity in Europe. The most of such projects have been implemented in Germany (Köhler, 2001). Consolidation centres show dynamic growth also in Great Britain, Holland and Italy (Brown et al., 2005; Quak, 2008). So far, in Poland there have been no UCC project implementations. 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. A considerable curb is also the cost of putting a UCC into operation and maintaining it. In practical terms, projects of this type are never self-financing and they cannot exist without external funds and support from the local self-government, the regional authorities or the state. This has contributed to even more difficulties in trying to persuade local self-governments to implement such projects. There is a chance that Polish local authorities will change their attitude to the problem of freight transport in urban areas and that the problem’s significance will become more visible. The hope lies in the new projects that are underway and involve some Polish cities. The ones worth noting are especially the two projects: SUGAR (Sustainable Urban Goods Logistics Achieved by Regional and local policies) which involves the city of Poznań, and the new project acronymed C-LIEGE (Clean Last mile transport and logistics management for smart and Efficient local Governments in Europe) which involves the city of Szczecin (by the way, the authors of this article have the pleasure to be members of the project’s research team). The projects to a large extent concentrate on exchanging experience and transferring good practices between the cities that have already been using urban logistics solutions and those which lack such experience.

4.2. The key technical and organisational assumptions for the idea implementation

It is possible to indicate many varied solutions regarding UCC implementation that are specific for the tasks (the deliveries volumes, their assortment etc.), the geographical area, the organisational and legal as
well as technical conditions. Brown et al. indicate several key factors that determine the nature of a given consolidation centre. These include (Brown et al. 2005):

- objectives of the UCC: a UCC can have either a single or multiple objectives which can include:
  - reducing road freight traffic levels (reducing goods vehicle movements in the urban area through improved consolidation or modal shift);
  - altering road goods vehicle types used (e.g. fewer light or heavy goods vehicles);
  - reducing the environmental impacts associated with goods vehicle activity (i.e. through reduction in total number of trips and/or greater use of environmentally-friendly vehicles);
  - improving the efficiency of urban freight transport operations (through improved load factor, and the need for fewer deliveries);
  - reducing the need for goods storage and logistics activities at urban premises which could result in improved turnover (through offering storage facilities at the CC, as well as other value added services);
- location of centre(s): in particular their proximity to the area served;
- spatial coverage of the UCC: the extent of the urban area that is covered can vary between UCC schemes from a single site up to an entire urban area;
- range and type of products handled;
- transport modes utilised;
- range of additional activities provided;
- flexibility of operations, for example fixed delivery schedules or on demand;
- ownership and operation of consolidation centre(s), for example whether public or private, and single operator or joint venture;
- financial issues, particularly the nature of any financial support;
- responsibility for transport operations, for example the same provider as the centre operator or a separate transport arrangement, and whether it is a monopolistic or competitive operation;
- degree of permanency of the centre and its operations;
- role of local authorities and other public sector bodies;
- compulsory or voluntary: a UCC can be operated on a voluntary basis in which users decide whether or not they want their deliveries to flow via the UCC. Alternatively, a UCC can be compulsory (either on a 24 hour basis or at particular times during the day) and goods must be delivered via the UCC rather than directly to the receiver’s premises;
- a freestanding initiative, or one incorporated into the wider policy and regulatory framework of an urban area or region.

Urban Consolidation Centre should first of all contribute to (Chwesiuk et al. 2010):

- reducing costs of transport - manufacturers supply of goods for recipients located in the city to the centre from which deliveries to the final customers are made after all supplies had been cumulated on a specified territory;
- better use of the transport fleet;
- reducing noise and pollution due to the use of environmentally friendly means of transport at the time and in the area where the traffic of traditional means of transport would be impossible (e.g. in the city centres by night);
- making order with cargo flow. It should be kept in mind that both wholesale traders and retailers appear to be located mostly on the same territory which is the cause of additional load, traffic jams and the supply routes crossed. In practice this leads to more intensive traffic between these points.
Having elaborated on the issues discussed in (Chwesiuk et al. 2010), the gathered research material was analysed, and the following key organisational and technical assumptions were formulated to help develop a supply delivery system to the seaside resorts in question, making use of consolidation centres.

- 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;
- additionally, it is important to mitigate the negative impact of transport on the natural environment; this is of particular significance in view of the fact that the main access roads to Międzyzdroje and Świnoujście run through the Wolin National Park, while all the seaside resorts due to their tourist and spa functions are characterised by considerable traffic limitations (narrow roads, one-way traffic, parking restrictions, etc.);
- as it is possible to indicate explicitly which of the two main sources of supply (Szczecin or Koszalin) prevail as the source of supply for the individual seaside resorts, it is necessary to aggregate those seaside resorts into two groups to be served by two independent UCCs – the delivery system will be based on the double $\lambda$ model (Tarkowski et al., 1998), presented in Fig. 3;
- due to the size of the seaside resorts and the explicit seasonality of deliveries, both consolidation centres should be subregional (their task will be serving one big town Świnoujście or Kolobrzeg and a few smaller resorts);
- the system is supposed to be financed by means of a public-private partnership (the basic part of the infrastructure would be financed with the self-government subsidies, while delivery costs would be financed by their recipients);
- ownership supervision of the UCC should be provided by the Province self-government;
- in the course of the project implementation it is necessary to account for the diversity of the assortments to be delivered;
- it is advisable to consider the possibility of using smaller delivery vehicles so that they could move freely within the seaside resorts.

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:

\[
\text{Gravity Centre} = \sum_{i=1}^{n} \left( \frac{P_i \cdot S_i}{T_i} \right)
\]
\[ C_{x,y} = \frac{\sum_{i=1}^{I} r_i e_i d_i + \sum_{j=1}^{J} R_j E_j S_j}{\sum_{i=1}^{I} r_i d_i + \sum_{j=1}^{J} R_j S_j}, \]

where,

- \( C_{x,y} \): centre of gravity with x- and y-coordinates;
- \( r_i \): 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.

Two separate calculations were performed: for the season time and out-of-season time. The analysis of the data regarding the deliveries organization and volumes with regard to the individual seaside resorts showed that during the tourist season the increase in the mean daily supply volume delivered from Szczecin is bigger by ca. 40% than in the case of deliveries made from Koszalin. Outside of the season, however, the volume of orders coming from Kołobrzeg increases the daily mean volume of deliveries made from Koszalin, which is then bigger by 22% than the volume of deliveries made from Szczecin. Additionally, as already mentioned, the town of Trzebiatów is supplied partially by Koszalin and partially by Szczecin. Therefore, in order to assure well balanced loading of the two consolidation centres both during the summer season and outside it, we suggest introducing the alternate arrangements:

- in the summer season (from June through September) one of the UCCs will be serving Świnoujście, Międzyzdroje, Dziwnów and Rewal, whereas the other will cover Darłowo, Mielno, Kołobrzeg, Ustronie Morskie and Trzebiatów;
- outside the season (from October to May) the town of Trzebiatów will be served together with Świnoujście, Międzyzdroje, Dziwnów and Rewal.

![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)](image-url)
The area in question 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);
- 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.

5. Conclusions

The presented issues are the continuation of the research initiated in 2008 and described in (Iwan et al., 2010). The previous study presented the main functional assumptions for the proposed concept of applying UCCs to optimize supply deliveries to the major seaside resorts of the West Pomeranian Province. Moreover, it discussed the external factors that could facilitate or hinder the potential project implementation. This study, in turn, has concentrated mainly on the aspects related to the transport issues as well as the organizational and technical assumptions. A detailed analysis was performed regarding the demand for deliveries, generated by the region’s key seaside resorts and their sources of supply. Additionally, the major transport routes have been analyzed. The roads technical condition and parameters have also been taken into account. The obtained data have made it possible to develop a supply delivery model based on two consolidation centres.

In the future, the authors intend to prepare a feasibility study for the presented solution. It is the intention of the authors of the article to arouse the regional authorities’ interest in the proposed concept. The results of the latest (autumn 2010) elections to the local self-governing bodies in Poland have created a favourable climate for discussion. Nevertheless, due to the specific nature of UCCs and possible implementation problems as well as the need for continuous subsidizing, the authors realize that the task is far from easy.

References