*Advanced Logistic Systems – Theory and Practice, Vol. 19, No. 4 (2025), pp. 21-32.*
https://doi.org/10.32971/als.2025.019

# DETERMINING THE LOCATION OF A DISTRIBUTION CENTRE USING CENTRE SEARCH BASED ON EMPLOYMENT DATA

PÉTER SCHEIN[1] – RÓBERT SKAPINYECZ[2]

***Abstract:*** *Urban freight transport presents significant challenges to the goals of sustainable mobility and energy efficiency. The aim of this paper is to provide an approach utilizing centre search and employment data for selecting the optimal location of a distribution centre designed for electrified urban freight transport. The application of the proposed method is demonstrated through a case study, in which a potential site for a logistics centre in and around Miskolc was identified, using multiple centre search methods such as area grids and radial models. The paper also presents additional practical results, including the required fleet size and the characteristics of the supply area. The findings highlight that with thorough planning and appropriate data collection, a logistics centre can significantly improve the efficiency and environmental performance of freight transport.*

***Keywords:*** *distribution logistics, centre search, employment data, electrification*

## 1. INTRODUCTION

The growing urban population and the explosive growth of commercial demands pose significant challenges to the urban freight transport system. Traditional transport models are increasingly unable to meet the expectations of sustainability and efficiency. At the same time, the electrification and environmentally friendly transformation of freight transport is becoming increasingly urgent. Logistics centres can play an important role in this process, as they can optimize transport routes, reduce emissions and facilitate the integration of alternative fuel vehicles into the logistics chain.

A number of examples can be identified for the positive effects of logistics centres in the context of sustainability. A positive example is the logistics centre in Nijmegen in the Netherlands, which provides the city centre with electric bicycles and natural gas vehicles, focusing on small businesses [1]. A simulation-based hub in Reggio Calabria (Southern Italy) significantly reduced transport distances and congestion, although operating costs increased. However, these were offset by route optimization [2]. These and other examples demonstrate that the proper allocation of a logistics centre can significantly aid the realisation of the goals of sustainable development as well.

The spatial structure and population density of cities strongly influence the way freight is transported. The concept of "freight landscape" can be used to illustrate how urban logistics strategies adapt to population and employment patterns, using the examples of New York, Los Angeles, Paris and Seoul. Paris is more concentrated, while Los Angeles has a more dispersed structure [3].

In the followings, in section 2 the theoretical background of an integrated approach will be provided that aims to find the optimal location of a distribution centre based on employment data and the use of centre search methods. Afterwards, in section 3 a case study will be provided based on the example of Miskolc and the surrounding region that

[1]BSc logistics engineer, University of Miskolc, Institute of Logistics, Hungary
schein.peter@student.uni-miskolc.hu
[2]associate professor, University of Miskolc, Institute of Logistics, Hungary
robert.skapinyecz@uni-miskolc.hu

demonstrates the applicability of the proposed approach. Finally, in section 4 the conclusions will be drawn based on the results.

## 2. DESCRIPTION OF THE APPLIED METHODOLOGY

### 2.1. Determining the relationship between purchasing habits and the employed population

The optimal location of a logistics centre requires mathematical models that aim to minimize material handling work. This requires two basic data: goods traffic and material handling distances. The estimation of goods traffic is based on the analysis of purchasing habits and the number of employees, which reflects the economic activity of a region (the methodology for determining distances is described in later sub-sections).

Based on the previous, the formula for calculating the amount of products purchased online in the surveyed area is the following:

$$Q = \sum_{i=1}^{n} (e_n \cdot p) \tag{1}$$

where:

- Q, total goods traffic in the surveyed area,
- $e_n$, the number of employed people living in settlements,
- p, the average number of products purchased online.

A core concept of the proposed methodology is that the goods traffic calculated for each settlement in the previous formula servers as the basis for the application of the centre search methods.

### 2.2. Centre search methods

In the standard (radial) centre search model, the starting point of the material flow is the logistics centre (source), whose destinations (drains) are located at discrete points, i.e. they have specific and known coordinates in space. The material movement is radial, which means that the transport from each source or sink to the centre takes the shortest straight path [4].

Finding the optimal location of a logistics centre is a deployment task that minimizes the material handling work between the sources and the drains (in this case, the single source is the logistics centre). The material handling work can be achieved by minimizing the distance, since the material flow intensity value is constant (Fig. 1). The objective functions strive to minimize the material handling work, taking into account the transportation distances, which can be determined based on coordinates [4]. The objective function of the problem is the following:

$$C = \sum_{i=1}^{n} \left( q_i \cdot \sqrt{(x_i - x_c)^2 + (y_i - y_c)^2} \right) \rightarrow min. \tag{2}$$

where:

- C is the location of the logistics centre,
- n is the number of drains,

- $q_i$ is the material flow intensity (goods traffic) between the logistics centre and the i-th drain,
- $x_i$ and $y_i$ are the coordinates of the i-th drain.

Solving the previous objective function usually requires the application of optimization algorithms (in the current research, the Excel Solver with nonlinear ARG was applied).

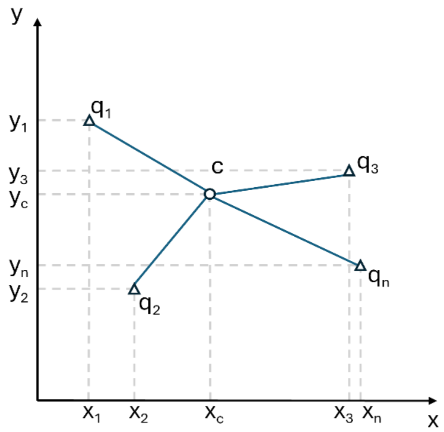


*Figure 1. Centre search model for sources or sinks located at discrete points, in the case of radial transport (own editing based on [4])*

Another method for determining the logistics centre is the area grid method, in which a scale grid must be constructed or laid out on the map. The area grid must be placed on the map so that a maximum of one object in a cell, in our case a settlement, is present. Then, the goods traffic is summed along each vertical and horizontal coordinate. After determining the goods traffic, the cumulative amount of goods traffic is calculated along the columns and rows in both directions, from top to bottom and bottom to top, or from left to right and right to left. In the last step, the smallest value among the absolute values of the differences in the cumulated material flows will determine the unit on the area grid that contains the optimal location of the logistics centre [4].

## 3. PRESENTING A CASE STUDY TO DEMONSTRATE THE APPLICATION OF THE PROPOSED APPROACH

In the followings, the search for the optimal location of a distribution centre in the Miskolc region (Hungary) will be presented using the proposed approach (a more detailed presentation of the research results can be found in Hungarian in the BSc thesis of the first author [5]). The goal was to find a location that on one hand minimizes the required material flow work, while on the other hand was also suitable to facilitate the application of a fully electrified transport vehicle fleet. To determine the location of the logistics centre, a total of seventy-nine settlements in the catchment area of Miskolc had to be considered. Each settlement had several pieces of data (two coordinates, freight traffic data, distance from the centre and freight transport work). The coordinates were one of the most important data sets, as they can be used to determine freight transport distances. A Google Sheets extension (the ezGeocode extension) provided a simple and quick solution for determining the coordinates (Fig. 2).

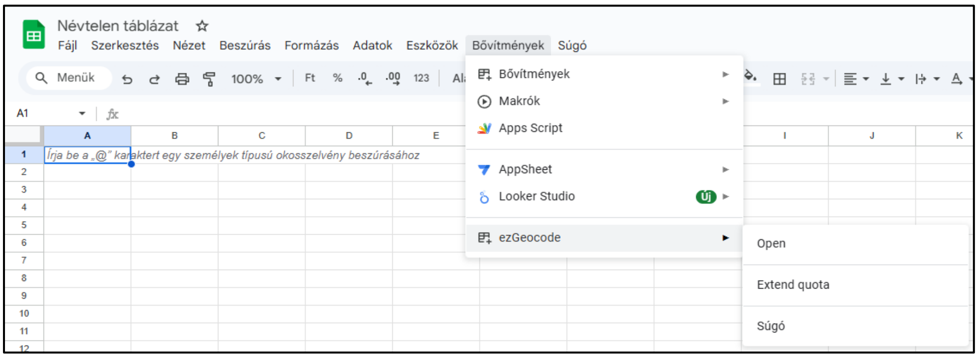


*Figure 2. Screenshot of using the ezGeocode extension for Google Sheets to determine the coordinates of settlements*

| | A | B | C | D | E | F | G |
|---|---|---|---|---|---|---|---|
| 1 | **Address** | **Status geocode** | **Formatted address** | **Latitude** | **Longitude** | **Type** | **Location Type** |
| 11 | Bükkábrány | Ok | Bükkábrány, 3422 Hungary | 47,8884157 | 20,6810544 | locality, political | APPROXIMATE |
| 12 | Kács | Ok | Kács, 3424 Hungary | 47,9574786 | 20,6145847 | locality, political | APPROXIMATE |
| 13 | Sály | Ok | Saly, Senegal | 14,443593 | -16,9889904 | locality, political | APPROXIMATE |
| 14 | Vatta | Ok | Vatta, 3431 Hungary | 47,9228447 | 20,7389995 | locality, political | APPROXIMATE |
| 15 | Alsózsolca | Ok | Alsózsolca, 3571 Hungary | 48,0748263 | 20,8850624 | locality, political | APPROXIMATE |
| 16 | Arnót | Ok, partial match | 600 Roe Ave, Elmira, NY 14905, USA | 42,1001264 | -76,8276065 | establishment, health, hos | ROOFTOP |
| 17 | Berzék | Ok | Berzék, 3575 Hungary | 48,0240535 | 20,9528886 | locality, political | APPROXIMATE |
| 18 | Bőcs | Ok | Bőcs, 3574 Hungary | 48,0442332 | 20,9683874 | locality, political | APPROXIMATE |
| 26 | Hernádnémeti | Ok | Hernádnémeti, 3564 Hungary | 48,0716822 | 20,9742344 | locality, political | APPROXIMATE |
| 27 | Kisgyőr | Ok | Kisgyőr, 3556 Hungary | 48,0096251 | 20,6874073 | locality, political | APPROXIMATE |
| 28 | Kistokaj | Ok | Kistokaj, 3553 Hungary | 48,0397115 | 20,8410079 | locality, political | APPROXIMATE |
| 29 | Kondó | No result | | | | | |
| 30 | Köröm | Ok | Köröm, 3577 Hungary | 47,9842491 | 20,9545886 | locality, political | APPROXIMATE |
| 31 | Mályi | Ok | Mályi, 3434 Hungary | 48,0175678 | 20,8292414 | locality, political | APPROXIMATE |
| 32 | Miskolc | Ok | Miskolc, Hungary | 48,1034775 | 20,7784384 | locality, political | APPROXIMATE |
| 33 | Nyékládháza | Ok | Nyékládháza, 3433 Hungary | 47,9933002 | 20,8429935 | locality, political | APPROXIMATE |
| 34 | Onga | Ok, partial match | 1475 Bergen Blvd, Fort Lee, NJ 07024, USA | 40,852449 | -73,986232 | establishment, food, point | ROOFTOP |
| 35 | Ónod | Ok | Ónod, 3551 Hungary | 48,0024425 | 20,9146536 | locality, political | APPROXIMATE |
| 36 | Parasznya | Ok | Parasznya, 3777 Hungary | 48,1688229 | 20,6402064 | locality, political | APPROXIMATE |

*Figure 3. Screenshot of the results of using the ezGeocode extension for Google Sheets to determine the coordinates of settlements*

The centre search was performed using two different methods, the aim of which was to make the results comparable. In case similar results are obtained using different methods, it supports the correctness of the calculations. The following models were used in the calculations: radial freight centre search model and the area grid method.

### 3.1. Applying a radial freight centre search model using Excel Solver

The table in Fig. 3 contains the coordinates of the settlements and cities, their goods traffic and their distance from the logistics centre, as well as the material handling work between each settlement and the logistics centre. In the first step, the material handling route, i.e. the radial distance, must be determined, which is done by applying the Pythagorean theorem.

The following formula gives these values in the Excel spreadsheet program for a given cell: „=GYÖK(($B$81-B2)^2+($C$81-C2)^2)" („GYÖK" stands for „SQRT"). By determining the distance of all settlements, an important element of the objective function of the applied model can be obtained, as can be seen in Fig. 4. The coordinates of the center can be obtained after running the Solver extension.

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Settlement | Y (coordinate) | X (coordinate) | Good traffic (q) | Distance | Material handling work |
| 2 | Alacska | 48,2157484 | 20,6502945 | 6720 | =GYÖK(($B$81-B2)^2+($C$81-C2)^2) | |
| 3 | Alsódobsza | 48,1799523 | 21,0026817 | 2688 | 52,55873326 | 141277,875 |
| 4 | Alsóvadász | 48,2401438 | 20,9043765 | 11172 | 52,57475089 | 587365,1169 |
| 5 | Alsózsolca | 48,0748263 | 20,8850624 | 49308 | 52,41540571 | 2584498,825 |
| 6 | Arnót | 48,131997 | 20,859401 | 22113 | 52,45763763 | 1159995,741 |
| 7 | Aszaló | 48,2177554 | 20,9624804 | 15477 | 52,57734798 | 813739,6146 |
| 8 | Bekecs | 48,1534102 | 21,1762263 | 24906 | 52,60402527 | 1310155,853 |
| 9 | Berente | 48,2385836 | 20,6700776 | 9198 | 52,48059695 | 482716,5307 |
| 74 | Tardona | 48,1699442 | 20,5314539 | 9828 | 52,36300338 | 514623,5973 |
| 75 | Tiszalúc | 48,0358262 | 21,0648205 | 41769 | 52,45157063 | 2190849,654 |
| 76 | Tiszaújváros | 47,9159846 | 21,0427447 | 152586 | 52,33295983 | 7985277,009 |
| 77 | Újcsanálos | 48,1380468 | 21,0036907 | 7140 | 52,52072517 | 374997,9777 |
| 78 | Varbó | 48,1631678 | 20,6217693 | 10206 | 52,39225231 | 534715,327 |
| 79 | Vatta | 47,9228447 | 20,7389995 | 7938 | 52,21786231 | 414505,391 |
| 80 | Ziliz | 48,2511796 | 20,7922106 | 3360 | 52,54038784 | 176535,7031 |
| 81 | Centre | | | | Total: | 171986174,6 |

*Figure 4. Application of the radial freight centre search model in Excel spreadsheet software*

Fig. 5 illustrates the distribution of goods traffic in the region based on formula (1), where the yellow background highlights the data for Miskolc (the employment data used in formula (1) was gathered from the site of the Hungarian Central Statistical Office [6]). Higher traffic can be observed in the vicinity of large cities – Miskolc, Kazincbarcika, Tiszaújváros, etc. – primarily due to the industrial presence and higher population. A total of seven settlements have a traffic (number of orders) of more than 50,000 units per year. These cities have a significant industrial background and a higher population [7]. A further 24 settlements have a traffic of 10,000–50,000, while 48 settlements have a traffic of less than 10,000 (the number of total orders is 3281208).

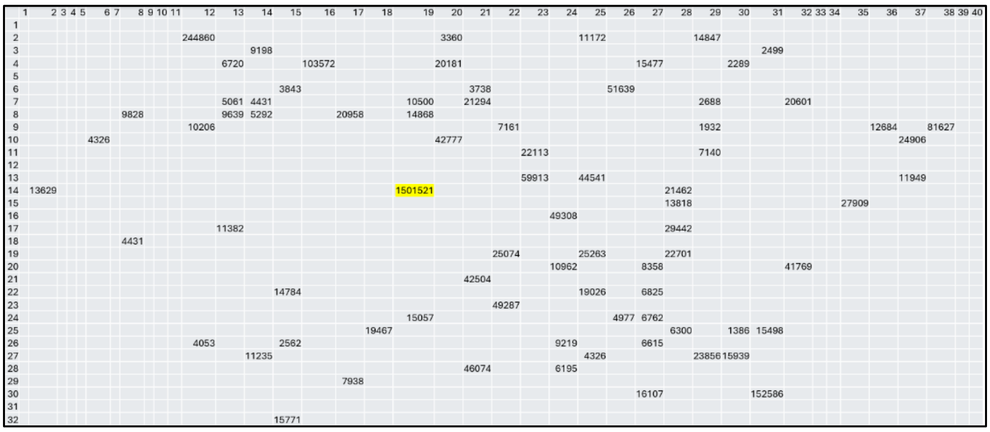


*Figure 5. Visual diagram of the distribution of goods traffic in the studied area*

Before running the optimization in the Solver extension, several settings must be made. In the case of the Goal, it is important that the algorithm performs a minimization calculation, therefore the Min value must be selected. After that, the variable cells to be modified must be specified, which will provide the value of the optimal coordinates of the logistics centre after running the Solver. When defining the parameters, it may be worth defining the Relevant Constraints as well, this will avoid the result being incorrect. Finally, it is important to note that the nonlinear ARG method was selected for solving the problem. Fig. 6 shows how these setting can be applied in the software, while Fig. 7 shows the results in the spreadsheet.

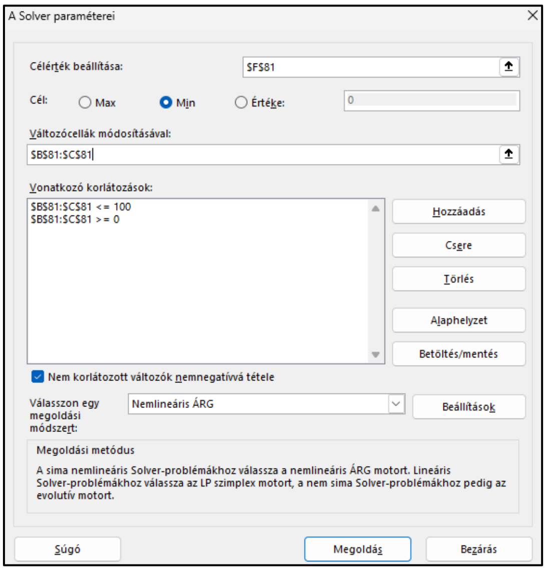


*Figure 6. Selection of the settings in the Solver extension for the application of the radial freight center search model*

| | A | B | C | D | E | F |
|---|---|---|---|---|---|---|
| 1 | Settlement | Y (coordinate) | X (coordinate) | Good traffic (q) | Distance | Material handling work |
| 2 | Alacska | 48,2157484 | 20,6502945 | 6720 | 0,170356849 | 1144,798023 |
| 3 | Alsódobsza | 48,1799523 | 21,0026817 | 2688 | 0,236920385 | 636,8419936 |
| 4 | Alsóvadász | 48,2401438 | 20,9043765 | 11172 | 0,185832202 | 2076,117365 |
| 5 | Alsózsolca | 48,0748263 | 20,8850624 | 49308 | 0,110411883 | 5444,189151 |
| 6 | Arnót | 48,131997 | 20,859401 | 22113 | 0,085834053 | 1898,048412 |
| 7 | Aszaló | 48,2177554 | 20,9624804 | 15477 | 0,216627141 | 3352,738256 |
| 8 | Bekecs | 48,1534102 | 21,1762263 | 24906 | 0,40090845 | 9985,02585 |
| 9 | Berente | 48,2385836 | 20,6700776 | 9198 | 0,173178557 | 1592,896367 |
| 74 | Tardona | 48,1699442 | 20,5314539 | 9828 | 0,255766197 | 2513,670188 |
| 75 | Tiszalúc | 48,0358262 | 21,0648205 | 41769 | 0,294269174 | 12291,32914 |
| 76 | Tiszaújváros | 47,9159846 | 21,0427447 | 152586 | 0,324065514 | 49447,86056 |
| 77 | Újcsanálos | 48,1380468 | 21,0036907 | 7140 | 0,227887924 | 1627,119777 |
| 78 | Varbó | 48,1631678 | 20,6217693 | 10206 | 0,167647678 | 1711,012201 |
| 79 | Vatta | 47,9228447 | 20,7389995 | 7938 | 0,184904881 | 1467,774947 |
| 80 | Ziliz | 48,2511796 | 20,7922106 | 3360 | 0,148325631 | 498,3741191 |
| 81 | Centre | 48,10349483 | 20,77843736 | | Total: | 364333,686 |

*Figure 7. Application of the radial freight centre search model in Excel spreadsheet software with the result for the location of the centre*

The Solver determines the coordinates of the logistics centre during its execution. Along with the determination of the result, all other data is also modified, since the formulas include the cells determined by the Solver (B81:C81). Thus, during the execution of the Solver, in addition to the optimal coordinates of the centre, it also provides the minimum of the material handling work. The optimal location for the logistics center, based on the radial freight transport model, would be the following coordinates: 48.1035:20.7784, which represents the coordinates of the city center of Miskolc.

The exact location of the center relative to the settlements is indicated by a yellow dot in Fig. 8, while the location of Miskolc is shown by a red dot. The yellow dot, which represents the center, almost completely covers the red dot, proving that the optimal location for the center would be in Miskolc.

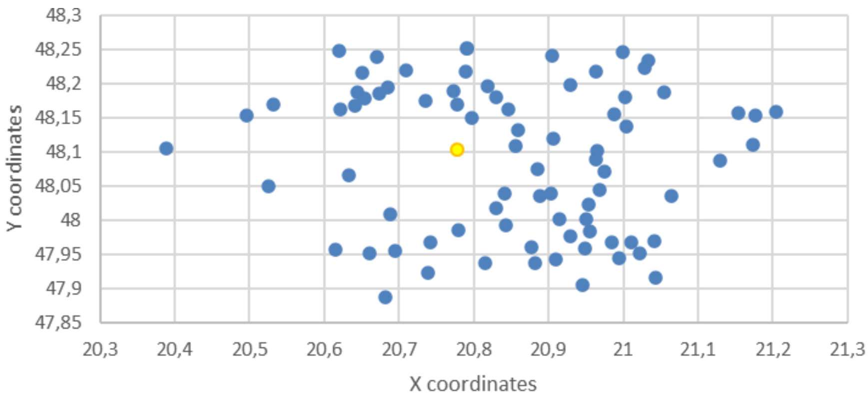


*Figure 8. Results of the radial centre search model for the location of the centre represented on an x-y coordinate plane*

### 3.2. Application of the area grid method

When applying the area grid method, several steps must be performed, which build on each other to ensure the optimal result. First, an area grid must be placed on the map so that only one object can be in the squares of the grid at a time. After editing the area grid and the map, the calculations must be performed and the result determined. The steps for applying the method, which are necessary for the result, can be read below.

The size of the examined area is nearly one thousand seven hundred and eight square kilometers, however, there are settlements that are located very close to each other. Due to this, the area grid is built up of a lot of cells, and when editing the area grid, care had to be taken to ensure that only one settlement is included in each cell. Sajókápolna and the nearby area to the west of it required special attention, where the borders of the settlements almost touch those of the neighboring villages.

The cells of the area grid were designed based on the lower part of the Google Maps marker icons, so each cell contains a single point representing a single settlement.

To perform the necessary calculations, the goods traffic of the settlements must be displayed on the cells of the area grid (Fig. 9). For this, the previously used Fig. 5 can be used, which shows the goods traffic of the settlements and its distribution based on the area grid shown on the map.

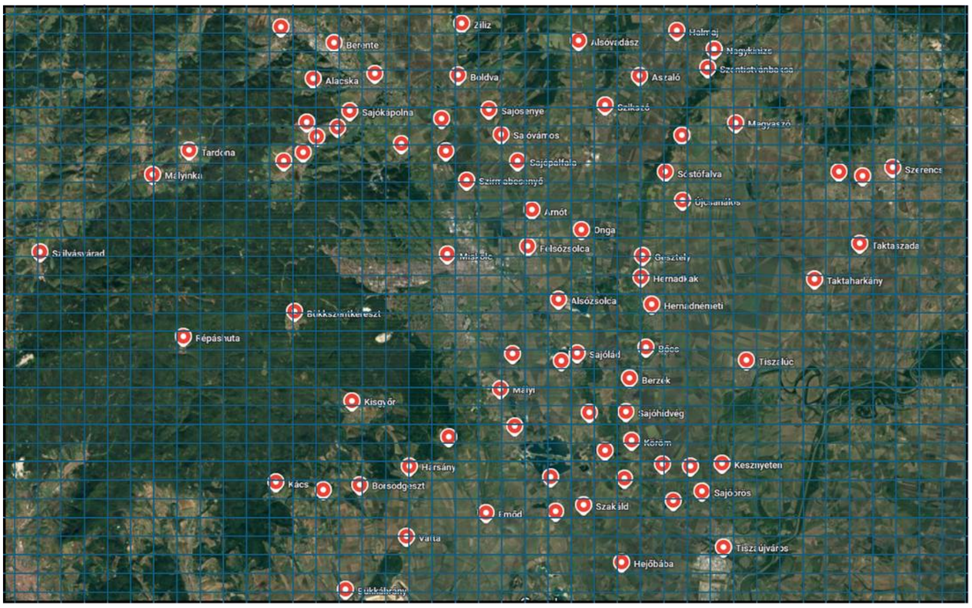

*Figure 9. Visualization of the settlements of the studied area and the correct placement of the area grid (based on Google Earth, using custom edit)*

The method involves performing simple mathematical operations (addition and subtraction) to determine the cumulative sums of the rows and columns of the table. The calculation was also performed in the Excel spreadsheet software. The results and partial results are displayed in the rows and columns next to and below the table as follows:

- The rows and columns marked "a" and "A" contain the sum of the volume of goods turnover per row and column, respectively.
- The rows and columns marked "b" and "B" contain the cumulative sum of the volume of goods turnover from top to bottom and from left to right.
- The rows and columns marked "c" and "C" contain the cumulative sum of the volume of goods turnover from bottom to top and from right to left.
- The rows and columns marked "d" and "D" contain the absolute values of the differences of the cumulative sums. The smallest value in row "d" and column "D" shows which unit of the area network is optimal for establishing a logistics centre.

Due to the simpler calculation and presentation of the final result, it was necessary to hide several rows and columns, so that the result can be easily seen, which can be seen in Fig. 10 on the next page, highlighted in red. The nineteenth column and fourteenth row of the table, which represent the goods traffic of Miskolc, would be the optimal location for the construction of the logistics center.

Using the area grid method, the city of Miskolc also proves to be the optimal location for the construction of a logistics center. Based on the calculations, it can be confirmed that both calculations were correct, since the first method results in the coordinates of the logistics center being in the area of Miskolc, while the result of the second calculation is clearly the cell representing Miskolc.

The result was presumably Miskolc because the city's population and employed population are several times higher than those of other settlements and cities. The population of Miskolc is almost six times that of the second most populous city of Kazincbarcika in the area.

| | 1 | 2 | 17 | 18 | 19 | 20 | 21 | 40 | A | B | C | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | | | | | | | | | 0 | 0 | 3281208 | 3281208 |
| 2 | | | | | | 3360 | | | 274239 | 274239 | 3281208 | 3006969 |
| 12 | | | | | | | | | 0 | 833427 | 2447781 | 1614354 |
| 13 | | | | | | | | | 116403 | 949830 | 2447781 | 1497951 |
| 14 | | 13629 | | | 1501521 | | | | 1536612 | 2486442 | 2331378 | 155064 |
| 15 | | | | | | | | | 41727 | 2528169 | 794766 | 1733403 |
| 16 | | | | | | | | | 49308 | 2577477 | 753039 | 1824438 |
| 29 | | | 7938 | | | | | | 7938 | 3096744 | 192402 | 2904342 |
| 30 | | | | | | | | | 168693 | 3265437 | 184464 | 3080973 |
| 31 | | | | | | | | | 0 | 3265437 | 15771 | 3249666 |
| 32 | | | | | | | | | 15771 | 3281208 | 15771 | 3265437 |
| a | 0 | 13629 | 28896 | 19467 | 1541946 | 66318 | 113610 | 0 | | | | |
| b | 0 | 13629 | 523719 | 543186 | 2085132 | 2151450 | 2265060 | 3281208 | | | | |
| c | 3281208 | 3281208 | 2786385 | 2757489 | 2738022 | 1196076 | 1129758 | 0 | | | | |
| d | 3281208 | 3267579 | 2262666 | 2214303 | 652890 | 955374 | 1135302 | 3281208 | | | | |

*Figure 10. Representation of the result of the area grid method*

### 3.3. Vehicle fleet considerations

The image in Fig. 11 shows the zones that an electric freight vehicle can serve with the current level of technological development. The centre of the zones is the Miskolc Southern Technology Park, as a possible location for the logistics distribution centre in question. The green zone depicts the area where they can perform logistics tasks without any problems and smoothly. The yellow zone is still serviceable by freight vehicles without running out of power, but the battery charge may presumably drop below the previously mentioned optimal charge level. The areas marked in brown and red fall at distances where electric freight vehicles are no longer able to serve without further charging, so it may be necessary to recharge the battery enroute. It is important to note that essentially all of the settlements examined are in the green zone, which makes the selected location suitable to facilitate the application of a fully electric transport vehicle fleet.

Based on previously calculated data in the case study, it can be determined that an average of sixty-three thousand one hundred orders are placed per week (this is determined by dividing the total number of orders with 52), which means at least twelve thousand six hundred twenty orders per day. People purchase a variety of different products during online shopping, of which the following are the most frequently ordered products: electronic devices (23%), consumer electronics (20%), books (19%), household and kitchen appliances (17%), and mobile phones and accessories (17%) [8]. In order to determine how many products can fit in a freight truck, their weight or volume must be determined. The table on the following page shows the average weight of the most frequently ordered product categories and the daily weight to be delivered for each category, based on the following formula:

$$M = p \cdot r \cdot m \quad (3)$$

where:

- M, the mass to be shipped according to product categories,
- p, the average number of online purchases made per day,
- r, the distribution ratio of the product category,
- m, average mass of products.

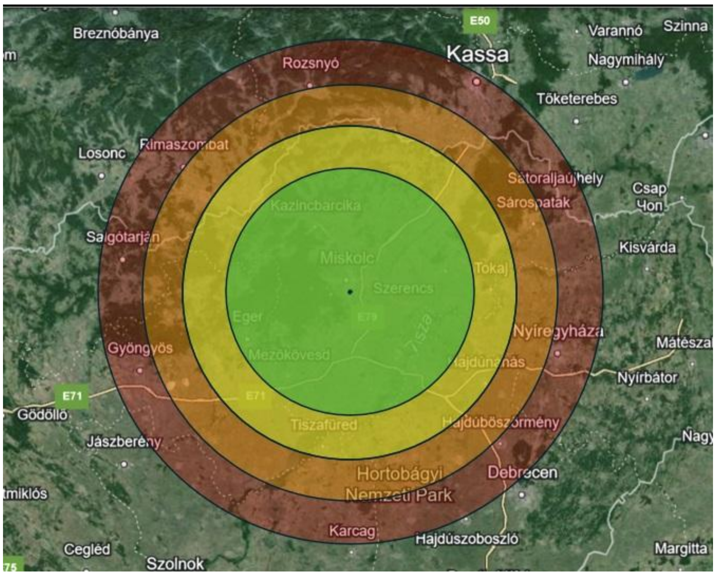


*Figure 11. Range zones for electric delivery trucks without charging (based on Google Earth, using custom edit)*

*Table I.*

*Average weight of the product category and the quantity needed to be shipped per day*

| ***Product category*** | ***Average weight [kg]*** | ***Quantity needed to be shipped per day [kg]*** |
|---|---|---|
| Electronics: | 5 | 14521,5 |
| Entertainment Electronics: | 3 | 7572 |
| Books: | 0,5 | 1199,9 |
| Household & Kitchen Appliances: | 7 | 14994,6 |
| Mobile Phones & Accessories: | 0,3 | 728,34 |
| **Total:** | | **39016,34** |

If we calculate with an average cargo capacity of 700kg for a standard small-sized electric delivery van, then the number of required vehicles can be easily determined according to the following formula:

$$P = \frac{T}{C \cdot u \cdot k} \tag{4}$$

where:

- P, the number of required vehicles,
- C, the total quantity of cargo needed to be shipped per day (39016,34 kg),
- u, the number of trips per day per vehicle (as an average value, it can be taken as 2),
- k, the average utilization value for the vehicles (it can be taken as 0,8).

Using the previous formula and the given parameters, it can be determined that 35 vehicles are needed to fulfil the transportation demand. However, it is important to note that this value is calculated for a representative average small-sized electric delivery van. The actual number could differ significantly depending on the concrete vehicle type to be utilized.

## 4. Conclusions

The aim of the article was to examine the possibility of using a centre search oriented method based on employment data for finding the optimal location of a logistics centre, which would also aid in the electrification of urban and regional freight transport, with particular attention to Miskolc and its 40-kilometer area. The case study demonstrated that, with appropriate planning and site selection, this objective can be realistically achieved with the proposed approach.

The paper determined the optimal centre location using two modelling methods, the radial centre search and the area grid method, which unanimously identified Miskolc as the most suitable location. The studies took into account the employed population, shopping habits, the goods traffic and spatial location of the settlements.

A modern, sustainably operating logistics centre with an adequate vehicle fleet, charging infrastructure and green energy sources would improve the efficiency of freight transport and contribute to the economic development of the Miskolc region and the achievement of its environmental goals. The establishment of such a distribution centre can be a complex but profitable investment, for which careful data collection, accurate modelling and cooperation between actors are essential. The proposed methodology could provide significant aid to the successful realization of this goal.

### References

[1] Quak, H. (2008). *Sustainability of urban freight transport: Retail distribution and local regulations in cities* (No. EPS-2008-124-LIS).

[2] Russo, F., Musolino, G. & Trecozzi, M. R. (2013). A system of models for the assessment of an urban distribution center in a city logistic plan. *WIT Transactions on the Built Environment*, **130**, 799-810. https://doi.org/10.2495/UT130641

[3] Rodrigue, J. P., Dablanc, L. & Giuliano, G. (2017). The freight landscape: Convergence and divergence in urban freight distribution. *Journal of Transport and Land Use*, **10**(1), 557-572. https://doi.org/10.5198/jtlu.2017.869

[4] Cselényi, J. & Illés, B. (2006). *Anyagáramlási rendszerek tervezése és irányítása I.* Miskolc University Press, Miskolc.

[5] Péter, S. (2025). *Logisztikai központ kialakítási lehetőségeinek vizsgálata és optimális elhelyezésének meghatározása a városi és regionális áruszállítás elektrifikációjának elősegítése céljából* (in English: Investigating the possibilities of developing a logistics center and determining its optimal location to promote the electrification of urban and regional freight transport), BSc thesis, University of Miskolc, Institute of Logistics.

[6] KSH: *Népszámlálási adatbázis* (in English: Hungarian Central Statistical Office: Census database). Retrieved from https://nepszamlalas2022.ksh.hu/adatbazis/#/ (last accessed: 2025.03.19)

[7] Varga, Sz. & Orosz, M. (2022). *Sereghajtóból az ország egyik gazdasági motorja: Borsod már az országos ipari kibocsátás 8,5 százalékát adja.* Retrieved from https://www.portfolio.hu/befektetes/20220506/sereghajtobol-az-orszag-egyik-gazdasagi-

motorja-borsod-mar-az-orszagos-ipari-kibocsatas-85-szazalekat-adja-542563# (last accessed: 2025.11.15)

[8] Marketing.hu (2023). *Átlagosan 21 alkalommal vásárolnak online a magyarok évente*. Retrieved from https://marketing.hu/cikkek/hirek/atlagosan-21-alkalommal-vasarolnak-online-a-magyarok-evente (last accessed: 2025.11.14)