Decision Analysis for Location of New Depot

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Facility location problem frequently appears in a business practice. The lack of availability of relevant income data is a determining factor for the selection of an appropriate method to solve the facility location problem. With different levels of knowledge concerning this problem, it is possible to use various methods.

Presented approach was tested on real data of the business company in Slovakia.

Decision Analysis for Location of New Depot

Decision making about building a new depot:

- **Usage of the exact methods or heuristics for solving so that problem – Plant Location Problem**

  Brezina- Pekár: Optimal location problem, Ekonomika a informatika 1/2006,

  Brezina – Pekár - Reiff – Čičková: Facility Location Problem Diagram. EURO XXII, Praha 2007

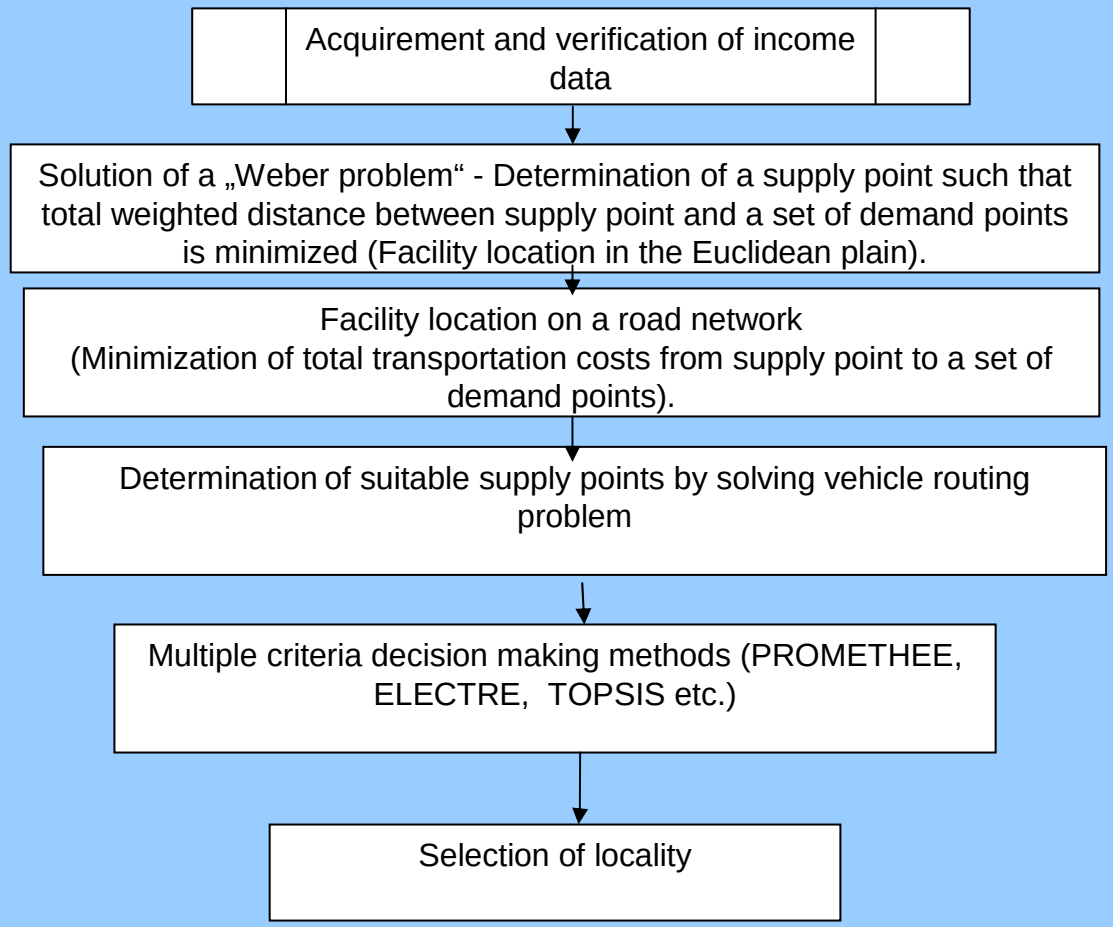
- **Multiple Criteria Decision Analysis**

  Pekár – Brezina – Čičková: Umiestnenie skladu pomocou metód viackriteriálneho vyhodnocovania variantov. AIESA 2008, Bratislava 2008

Feasible input data

- Number of customers,
- Demand of each customer,
- Minimal or preferred distances
- The distance of the potential locality from the highway,
- Concentration of the motorways,
- Capacity of vehicles,
- Price of building sites (m^2),
- Average salary in the region,
- Local tax rates,
- Influence on environment,
- Perspective of locality development etc.

Generalized procedure for a location of o new depot (Brezina – Pekár – Reiff – Čičková 2007)



Multiple Criteria Decision Analysis (Promethee II)

Definition of the problem (the goal is to maximize individual criteria (total number *k*):

$$"\max" \{y = (y_1, y_2, \ldots, y_k) \mid y \in Y\}$$

s.t.

$$Y = \{ \; y \in \Re^k \mid f \; \}$$

where

***y* – vector of evaluation criteria with size *k*, where y_k represents the *k*-th criterial (preference) function,**

***Y* – set of potential alternatives,**

The goal: a complete ranking of the alternatives in the form of preference structure (*P, I*) (choosing the best locality by using *PROMETHEE II,* where *P* represent the preference and *I* represents indifference).

Evaluation criteria

Selected criteria:

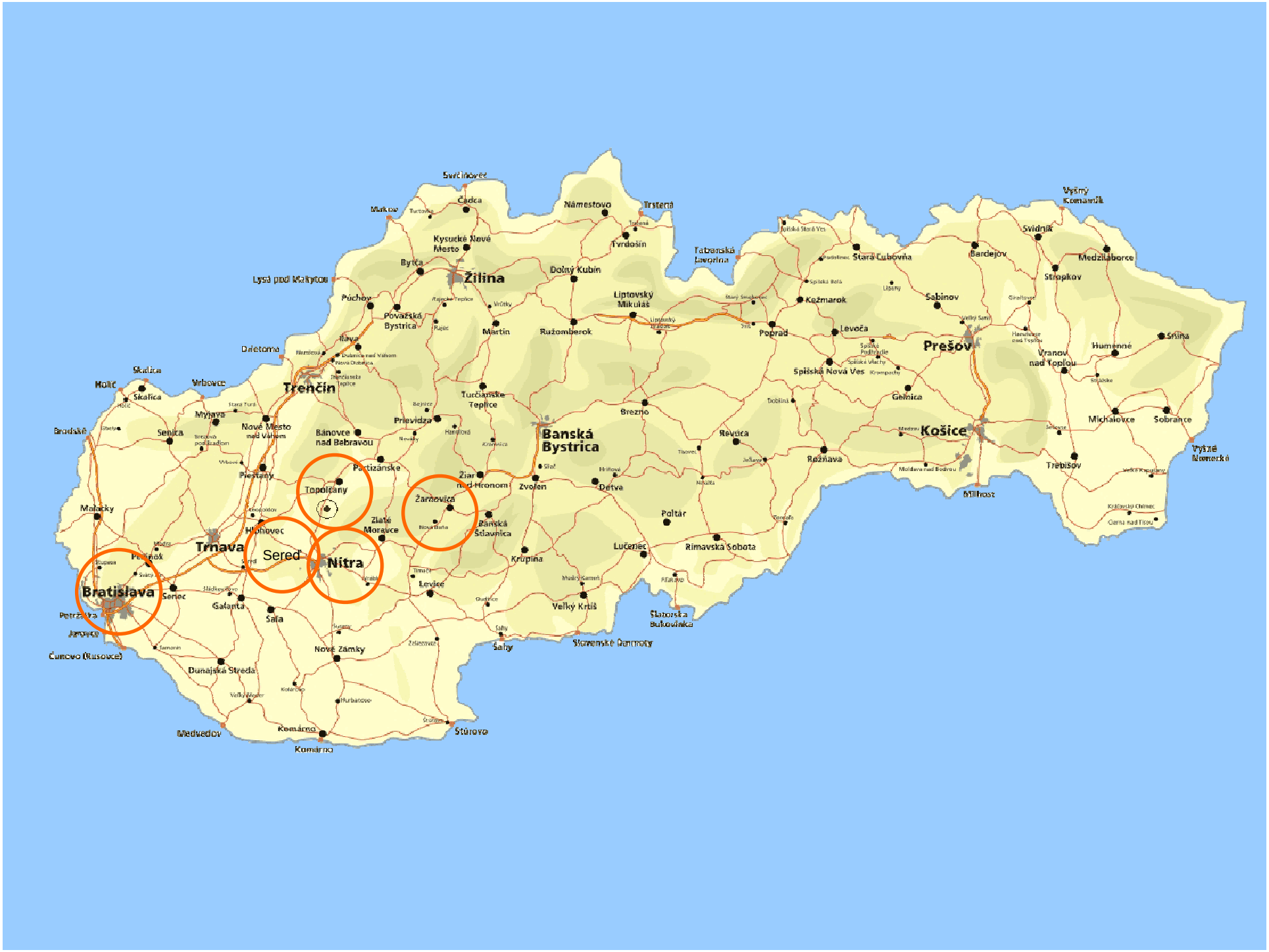
- **price of building site,**
- **average salary in the region,**
- **cost of the location change (in the case, we consider to move the existing depot),**
- **the distance from the preferred road,**
- **influence on environment (the impact of the building and increasing traffic in the locality),**
- **the distance of the management from the potential locality.**

The values of the evaluation criteria

	A_1	A_2		A_{1n}
1. Period distribution (in km)	a_{11}	a_{12}		a_{1n}
2. Price of the building site	a_{21}	a_{22}		a_{2n}
3. Average salary in the region	a_{31}	a_{32}		a_{3n}
4. Cost of locality change	a_{41}	a_{42}		a_{4n}
5. Distance from the preferred road	a_{51}	a_{52}		a_{5n}
6. Influence on the environment	a_{61}	a_{62}		a_{6n}
7. Distance of the management	a_{71}	a_{72}		a_{7n}

A_j – possible locality for the new depot, j = 1, 2, ..., n, (Nitra, Sereď, Topoľčany, Žarnovica and Bratislava)

a_{ij} – the value of the i-th criterion (i = 1, 2, ..., 6) for alternative j (j = 1, 2, ..., n)


Bratislava
Trnava
Nitra
Sered
Trenčín
Žilina
Banská Bystrica
Prešov
Košice

Criterion Period distribution in km *(min)*

Vehicle Routing Problem

Solution by Clark – Wrights methods (Brezina – Pekár 2006).

Data: The minimal distances between 32 customers were based on software AUTOROUTE 2002 (in km)

Final distribution for the possible localities:

1. **Bratislava – 2596 km**
2. **Sereď – 2493 km**
3. **Nitra – 2503 km**
4. **Topoľčany – 2581 km**
5. **Žarnovica – 2639 km**

Criterion Price of the building site *(min)*

Data: ***internet sources***

Average prices of the building sites designated as industrial site (for 1 ha):

1. **Bratislava – 35000000 Sk**
2. **Sereď – 6000000 Sk**
3. **Nitra – 13000000 Sk**
4. **Topoľčany – 8000000 Sk**
5. **Žarnovica – 5000000 Sk**

Criterion Average salary in the region *(min)*

Data: ***Statistical Office of the Slovak Republic on portal REGSTAT***

Average salary in the region (year 2006) :

1. **Bratislava – 29270 Sk**
2. **Sereď – 16411 Sk**
3. **Nitra – 18390 Sk**
4. **Topoľčany – 16343 Sk**
5. **Žarnovica – 16706 Sk**

Criterion Cost of locality change *(min)*

Data: ***internal assessment of analyzed firm***

Cost of locality change:

1. **Bratislava – 0 Sk**
2. **Sereď – 2000000 Sk**
3. **Nitra – 2000000 Sk**
4. **Topoľčany – 2000000 Sk**
5. **Žarnovica – 2000000 Sk**

Criterion Distance from the preferred road *(min)*

Data: ***the distances from the highways based on AUTOROUTE 2002***

Distance from the preferred road:

1. **Bratislava – 0 km**
2. **Sereď – 5 km**
3. **Nitra – 0 km**
4. **Topoľčany – 50 km**
5. **Žarnovica – 0 km**

Criterion Influence on the environment *(max)*

Data: ***That criterion represents the impact of building and operation of the new depot on environment. The scale reflect this effect from 1 (the lowest impact) to 5 (highest impact).***

Influence on the environment:

1. **Bratislava – 1**
2. **Sereď – 3**
3. **Nitra – 3**
4. **Topoľčany – 4**
5. **Žarnovica – 5**

Criterion Distance of the management *(min)*

Data: ***Distancies from Bratislava (present locality for the central depot) based on AUTOROUTE 2002.***

Distance from Bratislava:

1. **Bratislava – 0 km**
2. **Sereď – 59 km**
3. **Nitra – 88 km**
4. **Topoľčany – 124 km**
5. **Žarnovica – 156 km**

Input data

	Bratislava	Sereď	Nitra	Topoľčany	Žarnovica	Váhy
1. Period distribution (in km)	2596	2493	2503	2581	2639	0.5
2. Price of the building site	35000000	6000000	13000000	8000000	5000000	0.05
3. Average salary in the region	29270	16411	18390	16343	16706	0.2
4. Cost of locality change	0	2000000	2000000	2000000	2000000	0.05
5. Distance from the preffered road	0	5	0	50	0	0.05
6. Influence on the enviromnent	1	3	3	4	5	0.05
7. Distance of the management	0	59	88	124	156	0.1

Calculated values for parameters

	Bratislava	Sereď	Nitra	Topoľčany	Žarnovica	**F(+)**	**F**
Bratislava	0.00000	0.08537	0.11160	0.18025	0.24744	**0.15617**	**-0.28801**
Sereď	0.63335	0.00000	0.03685	0.40251	0.54002	**0.40318**	**0.37115**
Nitra	0.57372	0.00129	0.00000	0.33250	0.49992	**0.35186**	**0.29594**
Topoľčany	0.28939	0.01018	0.02710	0.00000	0.18800	**0.12867**	**-0.11462**
Žarnovica	0.28026	0.03130	0.04811	0.05789	0.00000	**0.10439**	**-0.26446**
F(-)	**0.44418**	**0.03203**	**0.05592**	**0.24329**	**0.36885**		

The ranking of the potential localities

Ranking of the potential localities using PROMETHEE II:

1. **Sereď**
2. **Nitra**
3. **Topoľčany**
4. **Žarnovica**
5. **Bratislava**

The best locality: Sereď

Conclusion

The best locality: Sereď