GEOMARKETING - A NEW APPROACH IN DECISION MARKETING: CASE STUDY – SHOPPING CENTRES IN IASI

Roşu Lucian[1], Blăgeanu Alexandra[1], Iacob Ionuţ-Ciprian[2]

Abstract. Geomarketing is the cornerstone of successful businesses in this age of digitization and quickly changing markets. After 1990, when we witnessed the liberalization of market, a new trend started to appear in Romania, namely the emergence of supermarket chains. The study uses quantitative models for measuring the accessibility to the existing shopping centres in Iaşi city, calculating thus their catchment area, information which is then used for identifying a suitable location for a new shopping centre. A previous step in the analysis was the classification of the existing commercial centres by using a diverse set of criteria that served for a more precise delimitation of the catchments area. As a final outcome we can point out that the location for a new hypermarket was validated by quantitative models.

Keywords: *Geomarketing, Reilly model, Location-Allocation, Service Area*

1. Introduction

In the last decades, some major changes in the retail outlets and food grocery had been produced in all Eastern European countries. Small corner stores disappeared in favor of retail and commercial shopping centres. Grocery stores, following the trend of many types of retail and businesses in the post-WWII era of urban sprawl, have abandoned inner cities in exchange for cheaper land, bigger stores, and more affluent customers (Jeanette Eckert, 2011).

In order to find these new locations, economic actors should take into consideration geomarketing strategies.

Geomarketing is a multifaceted approach that allows for both a comprehensive overview of market and company data as well as detailed micro geographic analyses. This flexibility is vital when attempting to maximize your potential and pinpoint your target groups in highly competitive markets, where both local and more wide-ranging factors must be taken into account. (Hardt-Beischl, 2012).

Customers are the main component of a successful business, and their spatial behavior is based on concepts such as principle of least effort, connectivity or accessibility.

Accessibility is a major issue for many types of stakeholders in policy making in the fields of transport, urban planning, marketing and public health. Because it may encompass more dimensions than the spatial one (e.g. temporal, social, economic), there is no single

[1] "Al.I.Cuza" University of Iasi, Faculty of Geography and Geology, Department of Geography, Bd.Carol I 20A, 700505, Iasi, Romania, luci_r2003@yahoo.com, alexandrablageanu@gmail.com

[2]Babes-Bolyai University of Cluj-Napoca, Faculty of Geography and Geology, Department of Geography, Mihail Kogălniceanu nr. 1, 400084, Cluj-Napoca, Romania, iacob.ionut.ciprian@gmail.com

established definition of accessibility. “Location-based” measurements deal with the spatial distribution of opportunities, generally at an aggregated level. “Person-based” measurements refer to disaggregated space-time accessibility measurements at the individual level. “Utility based” measurements are based on benefits assessment and utility maximization theory for both individuals and population groups (Salze, et al., 2011).

Why examine the access to shopping centres and their position in an urban area?

- An efficient location on urban area determines an exact number of possible customers, by identifying the catchment area of a land plot;
- To analyze competitive environment of a catchment area, to identify unmet demand for real estate of different types;
- To evaluate a certain location by different features such as: geographical conditions, transport infrastructure, social-demographic structure of customers and their spatial behavior;
- To analyze the feasibility of a new facility and the changes induced by it.

2. Materials and methods

In order to assess geomarketing solutions for the retail segment of the economic market in Iaşi city several data sources had to be assembled in order to come up with a coherent and valid database which was used in establishing the methodology of our research, as follows: data collection, statistical and geospatial analyses.

2.1 Data collection

Geospatial analysis methods that were used to identify the accessibility of population to shopping centres needed the following spatial data:

a. City population for each address;

b. Roads network classified into two categories: pedestrian and auto access. The network was extracted from Open Street Map and corrected according to field observations;

c. The existing buildings from the city which were used for the detection of possible future locations of a new supermarket and for spatial location of population; the shape file was obtained from the Assessor’s Office of Iaşi municipality;

For the statistical database several variables were collected:

a. Shopping centres location, commercial space (m^2), number of goods that are up for sale and number of parking places were obtained by accessing the online archives of the local newspapers.

b. The number of adjacent stores included into the commercial centres and their typology were collected from field observations in each location.

2.2 Statistical Methods

The database was statistically analyzed in order to obtain a general overview of the influences that retail centres have in territory according to their importance as follows:

a. For the *classification of the shopping centres* according to their importance five variables (commercial space (m^2), number of goods that are up for sale and number of parking places, number of adjacent stores included into the commercial centre and their typology) were taken into consideration; those were transformed according to index 100 for being integrated into a formula presented below that creates an image about the importance of shopping centres.

$$IMP_{shopping\ centre} = [Avg\ (I_c + I_g + I_p)\ x\ 2 + Avg\ (I_s + I_d)] / 2,$$ where:

$IMP_{shopping\ centre}$ - importance of an shopping centre
I_c - commercial space
I_g - number of goods that are up for sale
I_p - number of available parking places
I_s - number of adjacent stores
I_d - number of different categories of adjacent stores.

b. *Grasland spatial interaction model* takes into consideration primary the masses that are supposed to interact, the distance between them and secondly, the relative position of them within the analyzed spatial system. The model takes the following form:

$$Pi = \sum_{j=1}^{n} F(dij)mj,$$ where:

P_i - the potential at point *i* for any given type of opportunity
d_{ij} – the distance between *i* and *j*
F(dij) – an impedance travel function for travel between *i* and *j*
m_j – an opportunity at *j*

The model allows an approximation of the spatial behavior of a population located in unit j, describing the probability of interaction between the population of these units with those from units i; the results are given in percentages.

The next step consists of finding a function that describes the spatial interaction. The exponential functions describe a Gaussian distribution: slow at first, faster and slower at the end.

$$f(D) = \exp(-a * dij^b),$$ where

a – constant value which establishes the medium service area, respectively the distance at which the probability of interaction reaches the value of 0,5 (50%), which means half of the maximum probability of 1(100%) that indicates the centre of commune I, where d=0.

b - constant values which approximates the distance's impedance. For the analysis, the values of b are the following: 1,9 for Auchan and Chosen and 2 for Carrefour Era, Carrefour Felicia and Selgros.

According to above-mentioned observations, the model takes the form:

$$Pi = \sum_{j=1}^{n} mj\ exp(-a * dij^b),\ where\ a = [ln\ (0.5)/d^2]$$ (Groza, 2005)}

c. Reilly model

Reilly argued that all things being equal, two cities attract retail trade in direct proportion to some power of their populations and inverse proportion to some power of the distance of each of the 2 cities from an intermediate city. Reilly's theory can be carried one step further when considering various shopping centres' effects on the surrounding population. Simply stated, the relation between size of and distance between shopping centres is used to measure the probability of a resident in a given zone, patronizing a particular shopping centre (MacKenzie, 1989).

$$BP = \frac{Dij}{1 + \sqrt{\frac{Ai}{Aj}}},$$ where

BP - breaking point or maximum catchment area of a shopping centre
D_{ij} = distance between shopping centre i and j
A_i = surface area of shopping centre i
A_j = surface area of shopping centre j
i,j = shopping centre

2.3 Geospatial Analyses

a. Service Area

A network service area is a region that encompasses all accessible streets (that is, streets that are within specified impedance). For instance, the 5-minute service area for a point on a network includes all the streets that can be reached within five minutes from that point. Service areas created by Network Analyst also help evaluate accessibility. Concentric service areas show how accessibility varies with impedance (ArGis Resource Center, 2012). In order to define the service areas for the analyzed commercial areas, three different default breaks were used according to the classification described above:

- 650 meters, respectively walkability within 5'- 8' for all shopping centres (local market, supermarket and hypermarket);
- 1500 meters, respectively 5'- 10' (by car) for supermarkets and hypermarkets;
- 3000 meters, respectively 10'- 20' (by car) for hypermarkets;

b. Location-Allocation Mode

l

Location-allocation is a modeling technique, incorporated into GIS, that solves problems of matching supply with demand by using sets of objectives and constraints. In short, location-allocation determines the optimal location(s) of a service in order to serve the population in the most efficient manner. Location-allocation is used in the private sector to optimally locate warehouses, stores, and other private facilities. Location-allocation is also used in the public sector to optimally locate emergency services, schools, libraries, depots, warehouses and other public facilities. (Blazevic, 2004).

From the five types of location-allocation model, the most suitable for the analyses is maximizing coverage share. This option solves the competitive facility location problem. It chooses facilities to maximize market share in the presence of competitive facilities. Gravity model concepts are used to determine the proportion of demand allocated to each facility. The set of facilities that maximizes the total allocated demand is chosen (ArcGIS Resource Center, 2012).

Finding the most suitable position for a new shopping centre requires the following input data in location-allocation model:

- Candidate stores which were selected according to population density outside the 1500 meters service area of the existing supermarkets and suitability of built up area;
- Competitors – the existing supermarkets and hypermarkets;
- Demand points – the population for each address.

c. Origin destination cost matrix

The OD cost matrix finds and measures the least-cost paths along the network from multiple origins to multiple destinations. When configuring an OD cost matrix analysis, you can specify the number of destinations to find and a maximum distance to search (ArcGIS Resource Center, 2012).

3. Results and Discussions

3.1 Shopping centre' classification

The International Council of Shopping Center has defined eight principles shopping centres types according to their merchandise orientation (types of goods/services sold) and their size (ICSC, 1999).

Another classification of shopping centres, made by ***Marçenac*** *(2006)***,** proposes as criteria the following determinants: surface area, number of goods sold, and location.

With the purpose of having a more detailed image upon the importance of shopping centres, more variables (commercial space (m^2), number of goods that are up for sale and number of parking places, number of adjacent stores included into the commercial centre and their typology) were taken into consideration for the classification made according to the formula presented above; the results were grouped into three categories induced by the marked differences that occurred after applying the methodology(Table 1) . The table above distinguishes the following types :

Table 1: Shopping centres' importance score

No.	Shopping centre name	Importance score
1	Profi	50,3
3	Billa Minerva	50,6
2	Mercur Mary	63,3
4	Lidl Tatarasi	79,4
5	Lidl Canta	80,5
6	Lidl Galata	89,9
8	Carrefour Market Hala Centrala	100,0
9	Carrefour Market Iulius Mall	107,0
7	Billa Gara	107,5
10	Kaufland Pacurari	1207,8
12	Kaufland Nicolina	1354,3
11	Kaufland Alexandru	1365,9
13	Selgros	2083,4
14	Carrefour Era	3087,2
15	Auchan	3180,0
16	Carrefour Felicia	3316,7

a. *Local markets* – seven such shopping centres were identified with a score that varies between 50,3 and 107,5; these are located in proximity of neighborhoods centres, characterized by a high level of population density and the existence other services.

b. *Supermarkets* – three shopping centres belonging to the same supermarket chain (Kaufland) were included in this class – the score varies between 1207 and 1365. They are located in former industrial areas, on the periphery of neighborhoods (Păcurari, Alexandru cel Bun, Nicolina) as a bigger surface area is needed for retail.

c. *Hypermarkets* - four shopping centres were identified corresponding to this criterion; Usually, the hypermarkets are located outside the cities, in a specialized commercial area; but due to deindustrialization that took place during the '90s and in the context of urban renewal the named shopping centres are located inside of built up area of Iaşi city (except Carrefour Era). A possible example of urban renewal could be considered Auchan hypermarket, which is located in the newest complex shopping centre-Palas (in the centre of the city).

3.2 Service area

The principle of the least effort is considered to be the main principle that usually controls the daily activity of people:

If a task or an activity can be accomplished through different ways, the person who has to fulfill it will chose the situation that requires the least effort regarding money, energy or time. For a geographer, minimizing the effort means usually minimizing the distance and mobility (Goodall, 1987).

Accordingly, the service areas (Fig. 1) were delineated using three break values which correspond to each shopping centre types identified above:

a. 650 meters (walkability) for local markets based on the proximity to potential customers. This case represents the most typical example when the above-mentioned principle can be applied. For the service area analysis all shopping centres were included in this 650 meters breaking point values.
b. 1500 meters for supermarkets.
c. 3000 m for hypermarkets

The differences between hypermarkets and supermarkets are given by the facilities they offer. As a consequence, the principle of least effort has no further application; instead, a customer is willing to spend more time to reach a more diverse store, which offers him a wide variety of products.

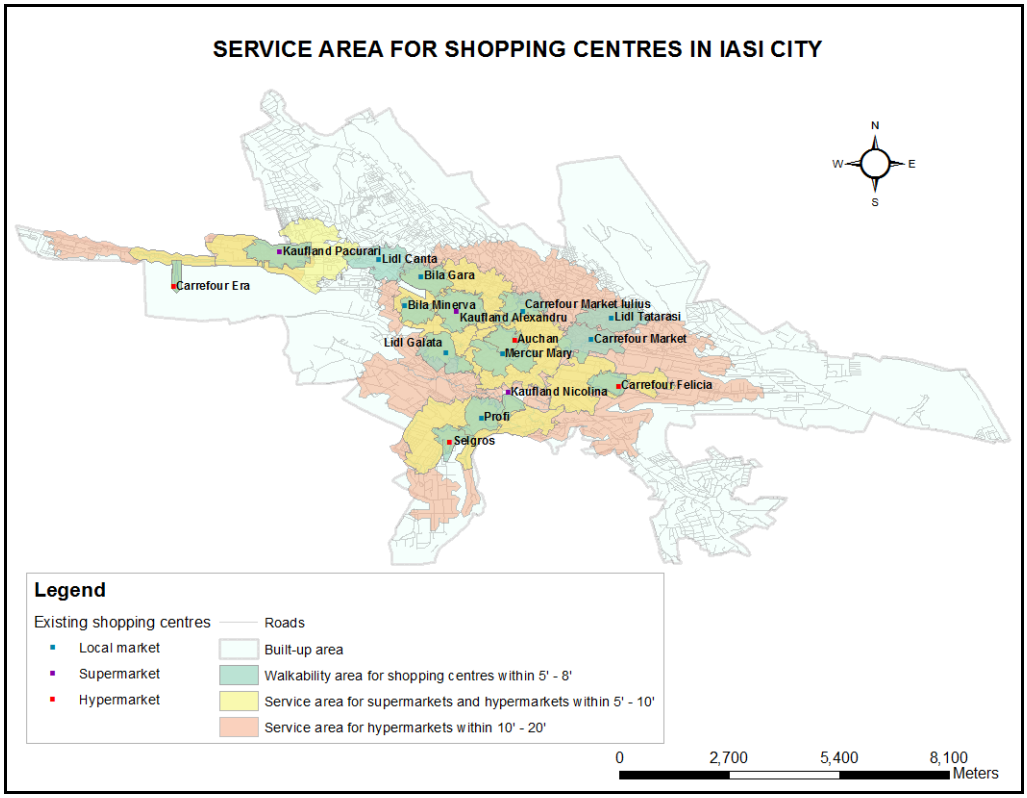

Figure 1: Service Area for the existing shopping centres

The location of the analyzed shopping centres (Fig. 1) does not correspond with the principles of urban planning that are applied in west-european countries (usually they are located outside of the city), all of them being located inside of it. In spite of their position, several areas remain outside of service area. These are the peripheral neighborhoods (Bucium, Copou-Agronomiei-Țicău, Tătărași and Dacia-Alexandru cel Bun) which have an unfavorable position, even if they concentrate a large amount of city's population.

3.3 Locating a new shopping centre

3.3.1 Identifing the most suitable places for a new shopping centre-Step 1

In order to evaluate a possible location for a new shopping centre, population density outside the service areas for 650 and 1500 meters was calculated. Thus, the highest values were obtained for Alexandru cel Bun-Dacia, Tătărași and Podu Roș neighborhoods (Fig. 2). The next step was to identify, based on our field observations, the most suitable locations where a new shopping centre could be built. The main criterion for choosing the locations was the extent of the available area, respectively a tract large enough for building a store as big as the existing ones. Hence, there were identified eight locations; some of them correspond with former industrial hales (Țigarete Factory, Remat Factory, former retail centre Siraj).

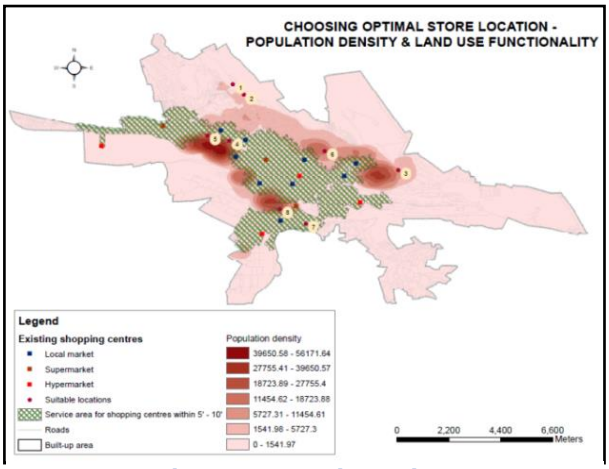

Figure 2: Choosing optimal store location-Step 1

3.3.2 Identifying the most suitable places for a new shopping centre – Step 2 (Location-Allocation Model)

According to the methodology explained at the beginning of the article, the chosen locations had as competitors the existing supermarkets and hypermarkets. Applying the maximize market share option, the model indicated the location were the next shopping centre could be built – Location 4 which corresponds with the former Țigarete Factory (Fig. 3).

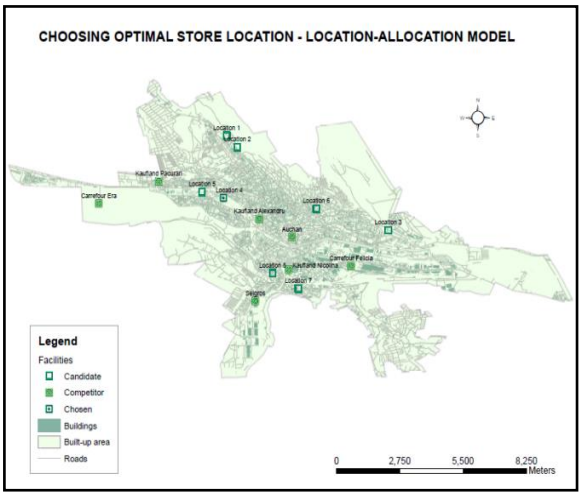

Figure 3: Choosing optimal store location-Step 2

The explanations for the final output are the following:

- the existence of three neighborhoods (Dacia, Alexandru cel Bun, Canta) with high density values of the populations which do not enter in the service are of the existing supermarkets and hypermarkets;
- a large surface area appropriate for building a complex shopping centre;
- the lack of other large shopping centres nearby.

The other seven proposed locations were excluded by the model because they would polarize neighborhoods that mainly consist of houses (Copou, Breazu, Țicău, Oancea) and consequently have low density population values.

Based on the explanations above-mentioned, the new shopping centre could take the form of a hypermarket. Hence, the next steps of the research will analyze the feasibility of its location within the existing ones.

3.4 Reilly and Gravity models. Changes in market share induced by a new hypermarket

In order to evaluate the changes induced by a new hypermarket two quantitative models were applied; first for the existing hypermarkets and then the chosen location was also taken into consideration.

3.4.1 Reilly model

The Reilly model offers an image of patronizing shopping area for each hypermarket taken into account.

The catchment areas of the existing hypermarkets (according to the Reilly model) cover only some neighborhoods which are in the proximity; the customers located beyond the breaking points face themselves with the situation of having to choose between two or more possibilities. Those are residents of the neighborhoods located in the South East and North West side of the city (residential neighborhoods) and also in the areas with the highest values of population density (Alexandru cel Bun-Dacia neighborhoods) (Fig. 4).

Therefore, a fifth hypermarket was taken into account in the analysis. The changes induced by a new shopping centre are visible especially in Alexandru cel Bun and Dacia neighborhoods, which also correspond with a less patronized area.

Another aspect that is worth mentioning is the change in what concerns the theoretical approximation of maximum possible customers of each hypermarket once a new shopping centre would be built.

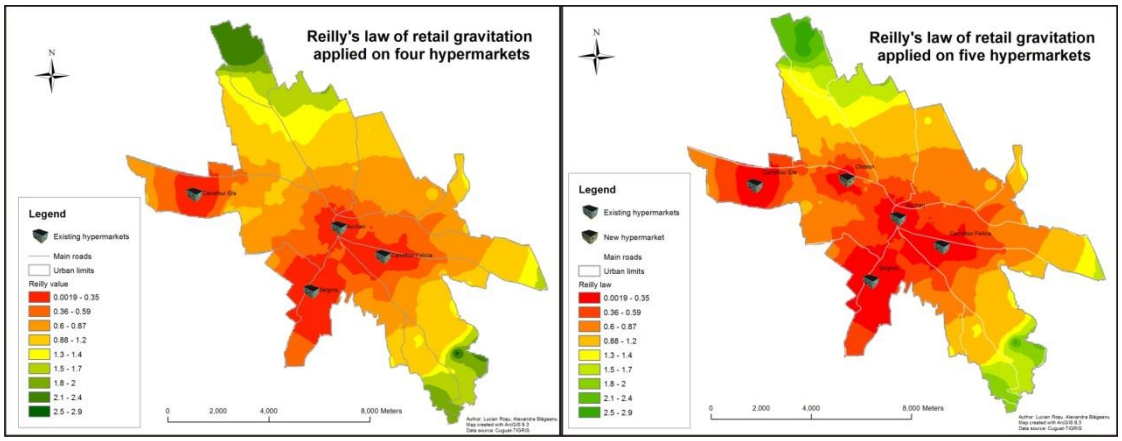

Figure 4: Reilly's law of retail gravitation

3.4.2 Gravity model

The analyses made for the existing hypermarkets conclude that their position can be characterized as being favorable or less favorable when the uneven distribution of population was taken into account. Hence, the highest probability of interaction is common for the customers that live nearby the hypermarkets; the longer the distance becomes, the lower the probability on interactions will be. For example, Auchan hypermarket due to his central position within the city has the biggest catchment area; by multiplying the value of the gravity model with the population of each address, a potential maximum number of customers was obtained – in this case 212.076 customers, which represents more than 70% of the city inhabitants.

Table 2: Changes induces by a new hypermarket

Hypermarket	Demographic accumulation	New demographic accumulation	Changes
Auchan	212076	135124	-76952
Era	4052	106	-3946
Felicia	10866	10866	0
Selgros	27255	27253	2
Chosen		107398	107398

Considering that the model is purely theoretical and in the same time does not take into consideration real flows and that the analysis was not conducted for the suburban fringes, but for the built-up area, the case of Carrefour Era hypermarket is highlighted; even if it has a strategic position along the main exit road from Iași city, this remains the only connection for the potential urban customers. The potential maximum number of customers in this case is 4062 customers, which represents only 1.5% of total population (Table 2).

When the same methodology was applied for five hypermarkets the following results were obtained (Fig. 5):

a. Customers with a high probability of interaction (over 85%) maintain their behavior which means that the existing shopping centres will have the same catchment area.

b. Changes can be observed for the customers who had a low probability of interaction with the existing hypermarkets in the situation mentioned above. As a result, a new shopping centre will increase these values of interaction, creating a new catchment area for those customers whose location was peripheral.

c. The proposed hypermarket, located on the former industrial hale Tigarete Factory, will have a number of potential maximum clients of 107.398 (almost 36% of total population), being the second most attractive hypermarket in the city.

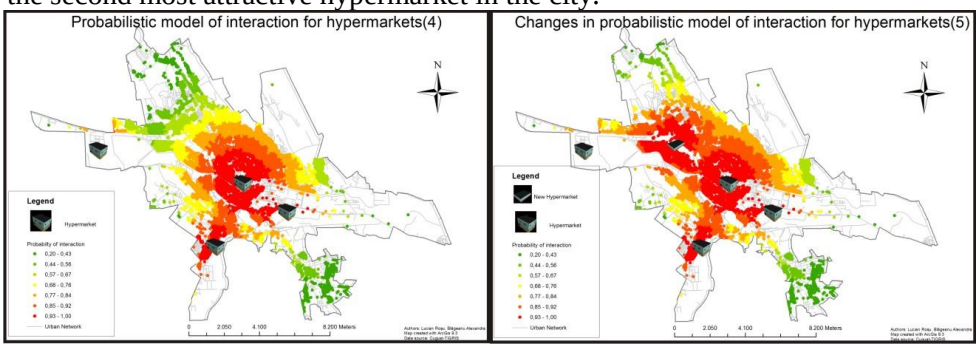

Figure 5: Probabilistic model of interaction

This theoretical approach validates the model of locating a new shopping centre.

Conclusions

By creating a new classification (that uses more criteria than) of the existing shopping centres in Iasi we were able to efficiently analyze their catchment areas. We can conclude that the distribution of commercial centres is rather uneven, because neighborhoods that remain outside the polarized area of each centre could be pointed out. Among these Alexandru cel Bun-Dacia neighborhoods are the ones that stand out being the areas with the highest values of population density. Also the Location-Allocation model indicates this zone as being the most suitable for building a new commercial centre. Using quantitative methods the location found for building a new shopping centre was verified.

The analyze reveals also that:

a. The more diverse are the variables take into consideration for the classification of shopping centres, a more precise and accurate the typology will be obtained; although many methodological approaches use as criteria the surface area of retail spaces, items such as number of goods that are up for sale, number of parking places, number of facilities offered by the commercial centre play an important role for the attractiveness of a shopping centre. The ranking of shopping centres created at the beginning of the paper influences the size of the service area; thus the more facilities a shopping centre offers, the larger its catchment area becomes.

b. According to the methodology used in the article, geomarketing solutions should be based on the next approaches:

- the least effort principle;
- positioning in the territory according to a hedonic model;
- suitability of the terrain for building a new facility;
- the rank of the facility;
- location-allocation model;
- quantitative models for evaluating the potential interaction between suppliers and customers;
- customers behavior.

The methods outlined in the research could serve as guidelines for future geomarketing studies. On the other hand in order to a have a more accurate output, a more complex database should be used – spatial behavior of clients, different characteristics of customers (income, age, level of education), types of means of transport used.

As a final recommendation for economic actors we suggest that when locating and planning a new facility, strategies of geomarketing should be taken into consideration because they offer a reliable foundation for expansion-planning decisions the results of which affect a companies' health for years to come. A geomarketing approach is therefore indispensible amidst the complex challenges post by today's global markets (Hardt-Beischl, 2012).

References

1. ArcGIS Resource Center. (2012, February 2). *Location-allocation analysis*. Retrieved November 19, 2012, from ArcGIS Resource Center: http://resources.arcgis.com/en/help/main/10.1/index.html#//004700000050000000
2. ArcGIS Resource Center. (2012, February 2). *OD cost matrix analysis*. Retrieved November 19, 2012, from ArcGIS Resource Center: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#/OD_cost_matrix_analysis/00470000004r000000/
3. ArGis Resource Center. (2012, February 2). *Service area analysis*. Retrieved November 19, 2012, from ArcGIS Resource Center: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html#//004700000048000000
4. Blazevic, A. (2004). *Using Location-Allocation to optimize the location of fire tanker airbases in California.* Illinois: Southern Illinois University Carbondale.
5. Goodall, B. (1987). *Dictionary of Human Geography.* London-New York-Voctoria-Toronto-Auckland: Penguin Books.
6. Groza, O. (2005). *Bazele teoretice ale planificării teritoriale.* Iași: Editura Universității.
7. Hardt-Beischl, D. (2012, November 1). *http://www.gfk.ua/.* Retrieved November 25, 2012, from http://www.gfk.ua/marketing_solutions/geomarketing/index.en.html: http://www.gfk.ua/imperia/md/content/gfkukraine/gfkbrochures/geomarketing_in_practice.pdf
8. ICSC. (1999). *ICSC SHOPPING CENTER DEFINITIONS*. Retrieved November 19, 2012, from ICSC: http://www.icsc.org/srch/lib/SCDefinitions.php
9. Jeanette Eckert, S. S. (2011). Food systems, planning and quantifying access: Using GIS to plan for food retail. *Applied Geography 31*, 1216-1223.
10. MacKenzie, B. (1989). Retail Gravity Model. *The Appraisal Journal*, 166-172.
11. Salze, P. e. (2011). Estimating spatial accessibility to facilities on the regional scale: an extended commuting-based interaction potential model. *International Journal of Health Geographics*, 1-16.
12. Salze, P., Banos, A., Oppert, J.-M., Charreire, H., Casey, R., Simon, C., et al. (2011). Estimating spatial accessibility to facilities on the regionale scalescale: an extended commuting-based. *International Journal of Health Geographics*.