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Concerning the application of gravity modeling network analysis

Kostiantyn Dolia
The National Aerospace University "Kharkiv Aviation Institute", Kharkiv, Ukraine
ORCID 0000–0002–4693–9158

Nataliia Kobrina
The National Aerospace University "Kharkiv Aviation Institute", Kharkiv, Ukraine
ORCID 0000-0001-9499-2079

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Abstract: The purpose of the article is to identify potential places placing objects commercial and entertainment infrastructure taking into account regional features . The analysis was carried out modern scientific and practical approaches calculation places Location commercial - entertainment objects in cities from taking into account factors territorial availability and population . Applied modern geoinformation technologies for carrying out network analysis means gravitational modeling . done calculation parameters attendance proposed objects commercial and entertainment infrastructure from taking into account requirements maximization attendance , increase market share and availability competitors .

Keywords: geoinformation technologies , gravity model, network analysis.

1. Introduction

Due with world processes integration and globalization began in Ukraine at the beginning of the 21st century to appear new one's species public spaces - shopping and entertainment centers. A shopping and entertainment center is one or the other sprat buildings, what include totality shops and various institutions which _ provide cultural and entertainment and social and household services. Shopping and entertainment centers today become one of the most popular species public spaces [1]. By score comfortable location, multifunctionality, compactness and saturation diverse services and entertainment trade and entertainment the center attracts huge flows of visitors, providing itself guarantee further existence. Taking into account that the construction of such institutions is a relatively new practice for Ukraine, it is relevant study regularities and basic trends their placement and functioning. Analysis the last one's research and publications.

2. Literature analysis

The theoretical basis of the research is works scientists [1] who determined main areas of study spheres service people objects. Ccommercial - entertainment infrastructure . At work [2] studied influence and placement market services from using different mathematical and geo-informational approaches. Work [3] considers modern placement and transformation market services in urban areas. Significance of placement factor for market services undeniable. Well done the location of the trade object provides him rack fundamental competitive an advantage for development. Consequently, optimization placement and evaluation. Location objects market services, in the first-place queue

trade, are engaged in many scientific and commercial organizations. Over the past 10-15 years published significant number works on this topic, primarily by economists, mathematicians and specialists in the field of marketing [4]. In more early works of technology and methodology in many ways relied on mathematical and economic analysis data, was later taken into account spatial factor. Economists come to solution given tasks from the side of marketing, mainly economic ones are used models' solution, while others scientists used in mainly mathematical models, for example, theory graphs, cellular method machines [5]. These works wear abstract nature and develop in direction complications and increases number factors that are used in models. New direction - substantiation and assessment location is not unique commercial object, but complex analysis networks [6]. Currently going trade market consolidation and others market services that requires new ones approaches in the assessment accommodation _ Old methods are not suitable, because with " good " placement of some objects network is getting worse quality placing others elements the same retail network. The authors emphasize that _ such methods as theory games, system analysis, cartographic methods are not given tall analysis results _ network as a whole. It is offered implement natural models which _ better describe nature: the inverse square law that describes interaction gravitational fields (Newton's law), the law of Biot -Savard-Laplace is a magnetic analogue of the law View metadata , citation and similar papers at core.ac.uk brought that you by CORE Land use , assessment land and real estate 99 Pendant Necessary note that the work has theoretical character, in it the authors modeled usage situation big quantity factors ,but as in others similar to this type of work in realities , is not taken into account historical factor, and the spatial factor is expressed only in the highway network in the form of a planar graph. Not discovered numerical Indexes connection between factors and operating room activity commercial objects through absence data [7]. A significant number of works on optimization and evaluation placing trading enterprises in many ways intersects with the new direction in the economy - geomarketing, which combines analysis spatial and attributive information in economic aspects [8].

This direction began to develop actively with the introduction of GIS technologies in marketing companies. Majority works written on this topic belong to economists, marketers and others interdisciplinary specialists. Mainly a disadvantage these there are jobs that applied geoinformation tools and models wear shallow character, the majority works relies on the " basic " toolkit in the form of analysis spatial relationship between objects, methods of buffer zones, assessment Euclidean distances main emphasis is on spatial geocoding, sociological survey and them analysis. In some works, presented descriptive analysis built local dense population [9], others are complemented creation adaptive methods method sociological surveys and construction shopping areas commercial objects [10]. In the works proposed grounds and options integration of marketing and geography through tools and approaches spatial analysis, what are used in geographic information systems.

Modern geographical research urban environment makes substantive contribution to development methods analysis accommodation. In [11] for analysis quality urban environment, which has many in common with by evaluating the accommodation conditions, singles out 5 main ones factors formation this environment: condition in transport system; position of objects commercial and social infrastructure; ecological the situation; position of objects of negative neighborhood (psychological discomfort); position of objects of positive neighborhood. For spatial bindings data, the author identifies a network of territorial cells size 150 by 150 meters. IN as a result modeling the first "transport" factors were resolved question evaluations size zones impact objects (estimate accessibility to stations metro, transport availability to the center and others indicators), the second - " infrastructural " factor, were also distinguished zones impact trading and others objects. In the end, the author, analyzing all others components quality urban environment, briefly describes essence spread phenomena in the form of buffer zones of influence and territorial availability. To determine the weight of each factor is applied sociological method surveys. Obtained as a result bitmap contains _ differentiation data _ urban environment. This research format suitable for geographic analysis territories on mesolevels, creation typologies districts. Next development work could serve typology micro- level areas for detection fundamental differences in quality urban

environment based selected factors. It is described in [12]. marketing approach to formation and development retail trade network cities _ It is based on its quantitative analysis sociological surveys people discovered significant factors accommodation and their connections among ourselves. The author compares discovered factors from foreign counterparts. If compare factor territorial availability services by time, then through a good one assortment potential customers they can spend additional 43 minutes, while foreign consumers spend only 12 minutes. At choice in favor of quality goods this the figure is 25 minutes and 11 minutes respectively. Factor low prices stands on the third place among consumers (18 minutes), which is very strange, while in the west this indicator stands on the first place and is 14minutes _ Divergence in consumer behavior the author explains buyers a wider range. European and American adjacent shops, what satisfy bigger part of needs; loyal conditions return, exchange and high quality goods in stores, high welfare people and culture on- site service granting market services Trace note that consumer behavior changes. Another advantage _ work is an analysis of the negative process side placement: why that or another object does not open in this place? In order to find the answer to this questions, the author conducts analysis by method sociological survey, but this time in quality take interview perform entrepreneurs _ Based on received results done such conclusions: the main factor that stops adoption decision about opening of a new point, there is competition, in second place - absence premises located on the pedestrian traffic, or problems with his for rent, on the third there are criminogenic ones factors and remoteness from places mass crowd of people [3,7,9,11].

Geoinformation systems allow get objective characteristics of placement, and if information collected from various territory, but using the same method, it is possible compare these Indexes among ourselves. Creation the only one bases by territory research allows in the future follow up dynamics changes indicators. Using GIS tools gives possibility analyze as small objects in the form street premises, as well as large - shopping centers and hypermarkets, where each type has object its location characteristics. The methodology includes the following key blocks: creation basic informative infrastructure research; creation base data thematic information; definition methods analysis in dependence from goals research and the nature of information [5,7,9,12, 13-15]. Creation base spatial and attributive distribution data numbers people. Density and placement population is one of the main one positive assessment factors _ locations commercial object, as directly there is a person final consumer goods and mail. Purpose and tasks articles. The purpose of this articles is to conduct analysis approaches definition placement and territorial availability potential places placing objects.

3. Object and subject of research

Object work - there is a modern planning system territorial placing commercial and entertainment complexes, objects infrastructure with taking into account regional features. The subject of the work is placement and territorial accessibility objects commercial and entertainment complexes.

4. Target of research

The purpose of the work is to identify potential places placing objects commercial and entertainment complexes taking into account their availability and regional features cities Kharkiv presenting main material research.

5. Research results

Necessary find due Location retail shops Rost to to provide maximum profitability trade network. The main one the goal is to locate the store nearby centers placing population and, in such way, to provide demand for the product. Based on this approach lying assumption that people make purchases

in the nearest stores more willingly than in distant ones. Necessary perform analysis places location-distribution, using three different types of tasks: maximization attendance, increase market shares and magnification target market.

Analysis layer places location-distribution added to the Network Analyst window. Classes lacy analysis: Points service (Facilities), Points of demand (Demand Points), Lines (Lines), Points barriers (Point Barriers), Linear barriers (Line Barriers) and Polygonal barriers (Polygon Barriers) empty. Added potential Location retail shops to class analysis network. Objects (Facilities). There are potential places where you can open shop. Decision in process placement-distribution provides subset these shops. Location potential shops added as layers The future stores (Future Roosts) to card document. Names shops are contained in the table layer attributes. Loading point objects from Potential shops in class objects of the placement-distribution layer.

Section Properties analysis place's location (Location Analysis Properties) dialog windows Download places location (Load locations) allows indicate which _ attributes class objects the future Shops contain values which will be used by Network Analyst during resolution tasks placement-distribution. To class analysis network Facilities downloaded thirty future shops. New one's objects listed in the Network Analyst window and displayed on the map that shown in fig. 1.

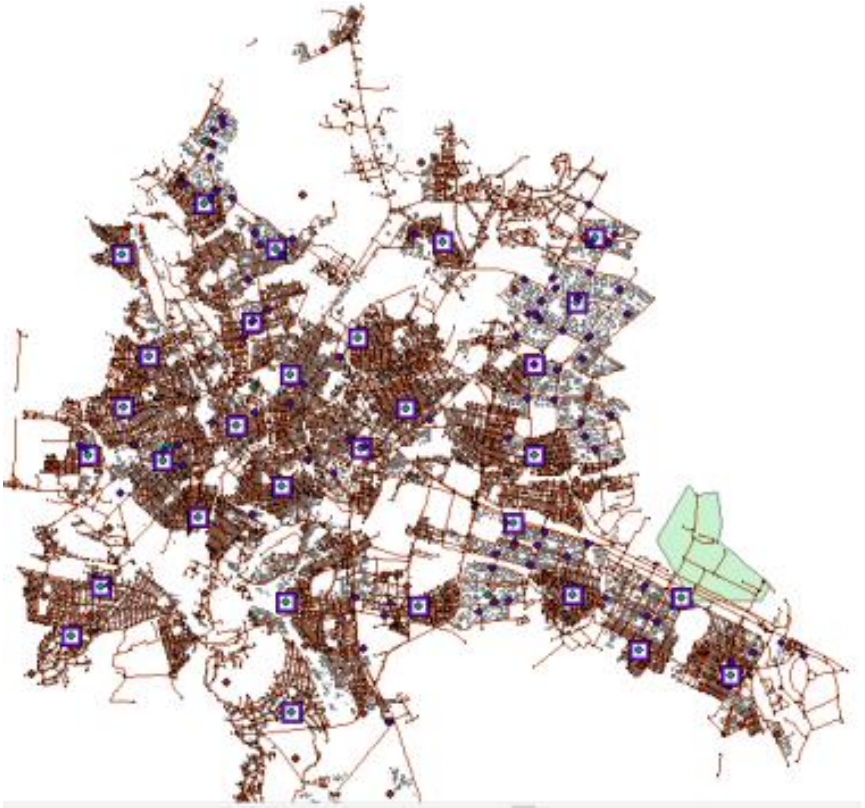

Fig. 1. Location potential objects.

Shops should be located as possible more convenient for the population. Point layer of contiguous quarters census already added to ArcMap. Further are loaded centroids in the class analysis network

Point of demand (Demand points). Each point of demand estimated by population according to the 2016 census. In the class Demand points (Demand Points) 44 points are loaded adjacent quarters census _ New points of demand accounted for and visualized on working region maps, fig. 2

Fig. 2. New points of demand.

By calculation finding the best Location shops received appropriate solution which is visualized on the map lines that _ bind selected shops with points of demand. Lines too are displayed in the Class lines (Lines class), fig. 3.

Fig. 3. Communication objects trading with demand points.

Addition competing objects and applications mechanism calculation placement-distribution allows locate new one's shops to o increase market share in view of the emergence competitors. Fraction market is calculated using Huff models, or models gravity. Huff's model assumes that what

probability visiting point shops demand depends from some property's shops, and also from distance to the store.

Properties are set analysis (support maximum market shares) Changed properties analysis layer placement - so that they fit to resolve tasks of the type Provision maximum market share. Process finding the best Location shops (support maximum particles market).

Demand points connected on the map lines with selected stores and competitors. It is not necessary forget that _ selected stores were changed to provide maximum demand in the presence of 97 competitors.

Among lines more overlays than in the previous one solved because _ each demand point in the supply problem maximum market share can interact with everyone objects in the zone impedance.

Changed targeted market share.

In the last one section total market share for three chosen one's stores is 94.71%. Suppose, however, to reduce market share up to 80%.

it is necessary to know the minimum number shops, which space will be needed for this their predominant accommodation. Task type Magnification target market share will help find the answer to this question.

After completion process decision in special messages specified targeted market share and umber stores necessary for it achievements targeted the market share is more than 80%, because in this case discovery fewer stores _ targeted the market share would be less the required 80%.

In addition to 97 competitors stores and six mandatory stores , now there are seven shops from Object type (FacilityType) Chosen (Chosen). It means that to achieve _ target market share 80% is required seven additional shops.

6. Conclusions

The possibility has been proven using methods geoinformation modeling market services from using Huff models. The method allows get quantitative and qualitative assessment positive and negative effects their mutual accommodation Assessment methodology placement and territorial availability market of services in large cities showed the suitability of GIS technologies for creation informative base research placing commercial objects in the city.

References:

1) Dolia, O., & Dolia, K. (2023). Metody rishennia zadach z orhanizatsii pasazhyrskykh perevezen avtomobilnym transportom. International Science Journal of Engineering & Agriculture, 2(3), 101–119. https://doi.org/10.46299/j.isjea.20230203.10

2) Mykhailova, I., Steba, A., Silvanskaya, G., & Vilshaniuk, M. (2023). Commercial and legal conditions for the organization of sea passenger transportation. Transport systems and technologies, (41), 155–169. https://doi.org/10.32703/2617-9059-2023-41-13.

3) Dolia, O., Dolia, K., & Mykhailova, Yu. (2023). Stan naukovoi dumky do pytan orhanizatsii perevezen pasazhyriv zaliznychnym transportom. International Science Journal of Engineering & Agriculture, 2(2), 182–188. https://doi.org/10.46299/j.isjea.20230202.17

4) Mykhailova , Yu., Navrozova , Yu., & Steba , A. (2022). Peculiarities of the organization of cruise transportation of passengers on yachts. Bulletin of the Azov State Technical University. Series: Technical Sciences, (45), 126–134. https://doi.org/10.31498/2225-6733.45.2022.276272

5) Dolia, O. (2022). Analiz stanu suchasnoi naukovoi dumky do pytannia orhanizatsii perevezen pasazhyriv riznymy vydamy transportu. International Science Journal of Engineering & Agriculture, 1(2), 23–39. vylucheno iz https://isg-journal.com/isjea/article/view/29

6) Shibaev, A., Borovyk, S., & Mykhailova, I. (2020). Developing a strategy for modernizing passenger ships by the optimal distribution of funds. Eastern-European Journal of Enterprise Technologies, 6(3 (108), 33–41. https://doi.org/10.15587/1729-4061.2020.219293

7) Dolia, K., & Kobrina, N. (2022). Zakonomirnosti zminy parametriv funktsionuvannia systemy mizhmiskykh pasazhyrskykh perevezen. International Science Journal of Engineering & Agriculture, 1(5), 132–138. https://doi.org/10.46299/j.isjea.20220105.14

8) Drozhzhyn, O. (2016). Containership Traffic Optimization on Feeder Shipping Line. Transport and Telecommunication Journal, 17(4), 314-321.

9) Dolia, O. (2022). Analiz stanu suchasnoi naukovoi dumky do pytannia vykorystannia zasobiv transportu pry pasazhyrskykh perevezenniakh. International Science Journal of Engineering & Agriculture, 1(1), 1–9. vylucheno iz https://isg-journal.com/isjea/article/view/1.

10) Drozhzhyn, O., & Revenko, O. (2018). Container shipping in period of Freight Conference breakup. Journal of Sustainable Development of Transport and Logistics, 3(1), 53-59.

11) Dolia, O. (2022). Analiz suchasnykh naukovykh pidkhodiv do rozrakhunku kilkosti pasazhyriv na aviatsiinomu transporti. International Science Journal of Engineering & Agriculture, 1(3), 247–272. https://doi.org/10.46299/j.isjea.20220103.20.

12) Scherbina, O., Drozhzhyn, O., Yatsenko, O., Shybaev, O. (2019) Cooperation forms between participants of the inland waterways cargo delivery: A case study of the Dnieper region. Scientific Journal of Silesian University of Technology. Series Transport, 103, 155-166.

13) Oleksii Drozhzhyn, & Yuliia Koskina. (2021). The Model of Container Feeder Line Organization Focused on the Nature and Parameters of External Container Flows. Communications - Scientific Letters of the University of Zilina, 23(2), A94-A102. https://doi.org/10.26552/com.C.2021.2.A94-A102.

14) Koskina, Y., Onyshenko, S., Drozhzhyn, O., Melnyk, O. (2023). Efficiency of tramp fleet operating under the contracts of affreightment. Scientific Journal of Silesian University of Technology. Series Transport, 120, 137-149. ISSN: 0209-3324. DOI: https://doi.org/10.20858/sjsutst.2023.120.9.

15) Mykhailova, Yu. V. (2023) Ustification of the approaches to placement of passenger vessels according to their directions of work and improvement of work planning of the shipping company's fleet. Transport systems and transportation technologies (25), 38–46. https://doi.org/10.15802/tstt2023/284493.