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ScienceDirect

Procedia Engineering 161 (2016) 1868 – 1873

Procedia Engineering

www.elsevier.com/locate/procedia

World Multidisciplinary Civil Engineering-Architecture-Urban Planning Symposium 2016, WMCAUS 2016

Procedure of Assessing Usefulness of the Land in the Process of Optimal Investment Location for Multi-Family Housing Function

Andrzej Biłozor[a,*], Małgorzata Renigier-Biłozor[b]

[a]*Department of Geoinformation Analysis and Cadastre, Faculty of Geodesy, Geospatial and Civil Engineering, University of Warmia and Mazury in Olsztyn, Prawochenskiego Str. 15, 10-720 Olsztyn, Poland*

[b]*Department of Real Estate Management and Regional Development, Faculty of Geodesy, Geospatial and Civil Engineering, University of Warmia and Mazury in Olsztyn, Prawochenskiego Str. 15, 10-720 Olsztyn, Poland*

Abstract

Spatial planning as a typical example of decision-making, resulting in the term land use is a complex and lengthy process. The procedure for assessing the usefulness of the land is associated with the determination of the possibilities and limitations for different types and forms of land use. In the process of determining the optimal use of land, the evaluation of the area usefulness with the use of geo-information was taking account. The purpose of this analysis is to make a choice of the optimal location of the investment, taking into account various criteria with a significant impact on the assessment of the usefulness of the land. The paper presents the possibility of applying procedures for assessing the usefulness of the land as a support tool in the process of planning decision. The procedure and criteria for selecting the optimal investment location for multi-family housing function is presented. The aim is also to present the parameters characterizing them and the possibilities of using geo-information that identify the restrictions and potential uses of the land. The dummy (0,1) maps of usefulness area was developed with the use of Boolean methods for all adopted criteria. The maps are indicating a set of locations that fulfil all the criteria of usefulness. The proposed procedure is also extended through the methods of significance and elimination of superfluous criteria analysis.

Peer-review under responsibility of the organizing committee of WMCAUS 2016

Keywords: evaluation of the usefulness of land, multi-family housing, optimization, multi-criteria analysis, geo-information;

* Corresponding author. Tel.: +48 895233588
E-mail address: abilozor@uwm.edu.pl

Peer-review under responsibility of the organizing committee of WMCAUS 2016
doi:10.1016/j.proeng.2016.08.720

1. Introduction

Management of space as a rare asset consists in making decisions about the intended use of an area to perform various social and economic functions. Management of space relies on the principle of economical production, which is to be analysed in the category of the maximisation of effects resulting from the possession of specific spatial resources, with simultaneous minimisation of outlays for the purpose of accomplishing the expected effects. The most frequently analysed problems call for taking into account, concurrently, multiple evaluation criteria when searching for an optimum solution. One of the tools in the process of designating optimum intended use of an area is a multi-criteria analysis, which consists in supporting the decision-making process in the case of having several or several dozen criteria at one's disposal. In this case the objective of such analysis is the selection of the most favourable location for a multi-family residential investment, taking into account various criteria that have a basic impact on the implementation and functioning of a given project. The study was prepared as a result of implementation of research project No. UMO-2014/13/B/HS4/00171 financed from the funds of the National Science Centre.

2. Review of the Literature

Spatial analyses performed with respect to the utility of an area in the process of optimising an investment location are inseparably linked to the term "real property", whose definition is usually limited to its determination as an element or a fragment of surface of land along with parts inseparably linked to it, such as buildings and fixtures. The optimum manner of using a real property, which may be characterised here as being legally permissible, economically profitable, properly justified, financially feasible and guaranteeing the highest quality [1], should also take into account the social and location aspects.

The variety and the imprecise character of spatial features, along with the extensive and multidimensional range of data results in the fact that the process of shaping space by the location of new investments is complex and long-lasting, and also encumbered with significant risk. Some of these features constitute a basis for determining an optimum location, whereas others have a limiting or excluding nature [2]. According to Griffin [3], making a decision is an act of choosing one possibility out of a set of possibilities. One of the tools in the process of designating an optimum intended use of an area is the evaluation of the utility of an area with the use of geo-information. The objective of such analysis is the selection of an optimum variant for investment location, taking into account various criteria which exert a fundamental impact on the evaluation of the utility of a given area. Geo-information is a spatially referred information. The determination of the features of space that are significant from the point of view of locating a specific type of investment leads to defining criteria which may be used when evaluating the utility of areas and the possibility of assigning them to a specific intended use. The term evaluation criterion in the performed analysis is understood as a feature of space which is used to classify and appraise physical and geographical phenomena in a given area. These are phenomena determining the utility of areas for planned investments [4].

The evaluation of the utility of a given area is related to the determination of the potential and restrictions for various types of use and forms of management. The determination of significant features leads to defining criteria which may be used to evaluate the utility of areas and the possibilities of assigning them to specific types of use. Such analysis should be conducted in two stages: the first stage should encompass the analysis of spatial determinants of the analysed area; the second stage should encompass the determination of the preferences of future investors [5].

The proposed system may be used to evaluate various types of investment and at various degrees of detail of spatial analyses. The final decision on location should take into account a number of social, economic and environmental factors, the analysis of which requires the application of a multi-criteria analysis [6,7,8].

3. Evaluation Procedure of Area Utility

The evaluation procedure of the utility of an area in the process of optimising the location of a multi-family residential investment is performed for the purpose of determining the restrictions and potential possibilities of using the area. When analysing a number of location, legal, environmental, social, economic, technical and utility factors that are significant from the point of view of the optimum location of a given type of investment, the authors have determined a set of ten criteria which have a basic impact on the success of a given project. In the decision making

process, with respect to the evaluation of the utility of an area intended for a multi-family residential development, the following criteria were taken into account:

1 – distance from the city centre (up to 10 km); 2 – distance from existing educational facilities (kindergartens, schools) – up to 4 km; 3 – distance from recreational areas (cultivated green areas) – up to 5 km; 4 – distance from large-surface service facilities – up to 2 km; 5 – distance from burdensome facilities (industrial plants, burdensome services, roads of supra-local significance) – above 500 m; 6 – access to municipal transport – a minimum of 2 lines in the neighbourhood; 7 – utilities – electricity, sewage system and water supply; 8 – surface of undeveloped land 5 – 8 hectares; 9 – convenient lie of land; 10 – fragmentation of land below 5 plots. The adopted criteria seem important from the developer's point of view (thence the estimated size of area, the minimum number of adjoining plots, the required technical infrastructure and convenient lie of land) and the expectations of future investors (potential buyers of apartments) with respect to the manner of management, preferences, needs and requirements of inhabitants, availability of social, trade, service, sports and recreational infrastructure and neighbouring areas.

The procedure of optimising the location of a residential investment was performed in the south-western part of the city of Olsztyn. Using the premises of Boole's rule, area utility maps were prepared for all the adopted criteria, in a standardised zero to one form (the so-called sharp analysis, where 0 designates useless areas which do not meet the premises of the criteria, and 1 designates useful areas, complying with the specified criteria), as well as a map determining the set of locations complying with all utility criteria. Subsequently, the logical intersection (common part) is determined – a set of locations complying with all utility criteria. With the use of GIS tools, an analysis of spatial data procured in the form of maps, digital databases and a numerical area model was performed. Maps presenting the evaluation of the utility of an area in the process of optimising the location of a multi-family residential investment for selected criteria are presented in Figures No. 1 and No. 2.

Fig. 1. Criteria No. 1,2,5. Source: author's own study on the basis of: www.geoportal.gov.pl.

Almost the entire analysed area is located at a distance of 10 km from the city centre (the distance was measured as a radius of a circle with its centre in the city centre). Half of the analysed area is located within a radius of 4 km from educational facilities (educational facilities according to www.msipmo.olsztyn.eu, such as schools, kindergartens, crèches, etc). The south-western fragment of the area does not meet this criterion. When selecting the place of the investment, areas located at a distance of 500 m from burdensome facilities (transit roads, route No. 51) were eliminated.

Fig. 2. Criteria No. 6,7,8. Source: author's own study on the basis of: www.geoportal.gov.pl.

Figure No. 2 shows an area serviced by at least two lines of municipal transport, areas provided with electricity, sewage and water supply system, and undeveloped areas with a surface area of 5 – 8 hectares. The resulting maps showing the utility of an area in the process of optimising the location of a multi-family residential investment with the use multi-criteria analysis for ten adopted criteria are presented in Fig. No. 3.

Fig. 3. Map with evaluation of area utility. Source: author's own study on the basis of: www.geoportal.gov.pl.

Taking into account the criteria used by potential buyers or developers, the adopted criteria may be treated as phenomena determining the utility of areas for planned investments. The drawback of this method may be the strong affiliation relation which does not foresee any intermediate situations. Within the analysed area there is no area complying with all the stipulated criteria. Therefore, the proposed procedure should be extended onto an additional element of importance analysis with the elimination of superfluous criteria used in the case of the absence of clear results. On account of the qualitative description of some criteria adopted for analysis, a direct comparison matrix was used for the purpose of determining the importance of the adopted conditions (Table No. 1). Thanks to this method, it is possible to evaluate the rank of individual criteria in a simple and legible manner – both for the developer and for the potential buyers, as well as to eliminate the least important criteria in the case of the absence of an optimum

solution. Completing the matrix consists in determination and marking, with the use of arbitrary signs, which of the compared criteria are more significant (marking with the symbols ↑ or ←), or whether they are equivalent (marking with the symbol =), where the symbol ← means 2 points, = 1 point and ↑ 0 points [9]. Table No. 1 presents an example of the matrix.

Table 1. Direct correlation matrix among criteria adopted for the evaluation of area utility.

Lp		1	2	3	4	5	6	7	8	9	10	∑
1	distance from the city centre		←	←	←	=	←	=	=	←	←	15
2	distance from existing educational facilities	↑		=	=	↑	=	↑	↑	↑	↑	3
3	distance from recreational areas	↑	=		=	↑	=	↑	↑	↑	↑	3
4	distance from large-surface service facilities	↑	=	=		↑	=	↑	↑	↑	↑	3
5	distance from burdensome facilities	=	←	←	←		←	=	←	←	←	16
6	access to municipal transport	↑	=	=	=	↑		↑	↑	↑	↑	3
7	utilities	=	←	←	←	=	←		=	=	=	13
8	surface of undeveloped land	=	←	←	←	↑	←	=		=	=	12
9	convenient lie of land	↑	←	←	←	↑	←	=	=		=	11
10	fragmentation of land below	↑	←	←	←	↑	←	=	=	=		11

The total of points specified for individual criteria shows which of them are the most significant and which may be potentially omitted when there are no clear results for all parameters. According to research performed for the needs of the study, it turned out that the most significant criteria refer to location (distance from burdensome facilities and from the city centre), utilities, legal status and level of development. The direct comparison method is a simple and legible solution to the problem of limiting the number of criteria adopted in the process of evaluating the utility of an area when selecting an optimum location for a residential investment. The main advantage of the proposed method is its facility in the interpretation of obtained results and methodological premises, which guarantees its utility.

4. Conclusions

Optimisation is a complex procedure aimed at finding the best solution for a given activity observing all the existing restrictions. The best possible variant is searched for in the set of permissible variants. The concept of the optimum use of a given space is one of the foundations for defining value used in domestic, European and international appraisal standards. The analysis and selection of a proper location and manner of management are inseparable elements of the process of spatial management and real property management. Emotional visualisation of space differs significantly from economic understanding. The same real property may have different importance for various participants of an investment process, and therefore completely different value. Optimum use may also result from the personal evaluation of the buyer, which is an outcome of the impact of intangible aspects, such as historical and environmental awareness, identity, or sentiment for a given place. The evaluation of the utility of an area in the process of optimising investment location requires analysis and verification of a number of criteria. The proper selection and verification of such criteria influence the success of a given project.

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