

Research of Industrial Real Estate Location Decisions Based On Gis: A Case Study of Xi'An

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Abstract. Recently, industrial upgrading and transfer in China directly promoted the development of the industry of real estate, location of correctly or not closely related to the success or failure of the project. This issue takes Xi'an as an example, selected the spatial factors affecting the real estate industry project locating, combined with the G1 method to build location model, finally with the help of Arcgis software has carried on the empirical. The results will be divided within the project study area siting decision space into five hierarchical levels; factor the cost of land, traffic conditions, policies and resources at the site for an important consideration; verify the applicability of the model, can provide a decision-making reference for the future.

Keywords: Industrial Real Estate; Location; Spatial Analysis.

1. Introduction

With the development of global economy structure the in the 21st century, China's manufacturing industry development has undergone profound changes, cities face the urgent and double tasks: industrial restructuring and spatial layout reconstruction. China's real estate market experienced a "golden years", the traditional residential development into the low-profit competition stage, it forced more real estate companies looking for new strategic transformation direction. Against this background, the introduction of industrial property within the city can makes up for the gaps of urban industrial structure, and reverses the development of urban spatial structure of "hollowing out "trend through integrating the construction of production, life, business and other functional areas and advancing function mixing and industry integration.

Industrial real estate location problem includes regional spatial analysis and the location of the project location. Throughout about the research of industrial real estate in China, we find related research mainly on the domestic real estate industry development present situation, development prospect and problems, inductive operation mode and operational risk, based on the experience of the developed countries, put forward the development strategy, etc. Study of geographic space location is few, such as Chen Hanxin (1986), Wang Weinian (2006) for the industrial park of the construction of the location factor has carried on the qualitative analysis, Dai jun (2014) using grey system theory for a given number of plot to the scheme comparison^[1-3].

On the basis of predecessors' research, this paper through the quantitative analysis factors affecting the location of the industry of real estate space, establish the project's location model. Depending on the geographic information system and its spatial analysis tools, the model will provide scientific basis and theoretical support to industrial property project location decision-making.

2. Research Methods

2.1 Model building

Adding spatial relations in the distance as constraints to multi-factor evaluation model. The model is set up as follows:

$$F = \max f(t) = \sum_{s=1}^n \mu_s \times t_s \quad (1)$$

F—multifactor weighted value; μ_s —the s-th weights of indicators; t_s —the s-th index of a single factor.

2.2 Method of weight assignment

This issue choose the revised comprehensive entropy of G1 method as a method to determine the weighing values of space factors. G1 method is invention by Guo Yajun^[4]. This method avoids the traditional AHP judgment matrix due to inconsistent and Delphi caused by repeated selection of distortion effects on weight. It has such advantages like high reliability, good validity and strong order-preserving benefits. Method to determine the weight of each factor as follows:

Identify the indicators with the principled, will be numbered $X_1 \sim X_j$

Order to determine the relationship between the evaluation by experts $X_1 > X_2 > \dots > X_j$ ($j=1,2,3,\dots,n$) ">" The implications of its indicators on the left are important than the right index.

Rational assignment given by experts in order relation adjacent indicators of the relative importance of r_j .

Table 1 r_j reference scale

Situation	r_j
X_j is equal to X_{j-1}	1.0
X_j is a little important to X_{j-1}	1.2
X_j is general important X_{j-1}	1.4
X_j is highly significant to X_{j-1}	1.6

Formula of G1 Calculation evaluation

$$\omega_n = (1 + \sum_{j=2}^n \prod_{i=j}^n r_i)^{-1} \quad (2)$$

ω_n ——G1 legal rights the n-th evaluation indexes;

3. Application

Xi'an is the capital of Shaanxi Province, located in the middle of the Guanzhong Plain, an important national research, education and industrial base. In recent years, electronic information, new energy automotive, aerospace, new materials, bio-medicine and other strategic emerging industrial scale rapid growth and these become the pilot of the national economy and pillar industries in Xi'an. In 2014, the strategic emerging industries increased by 16.8%, 6.9 percentage points higher than the growth rate of gdp. Faced strategy under construction of the "One Belt and One Road" project, the future of reform and opening up new positioning inland highlands, as well as the practical needs of economic development of Xi'an transformation and upgrading, and how to provide new space for these industries, are resolved problem development of Xi'an in the future.

3.1 The Research Variables

This paper establishes quantitative indicators system to qualitative factors. According to the high-tech strategic emerging industries, low resource consumption characteristics. The main factor in establishing traffic conditions, ecological landscape, service facilities, social environment, science and technology environment, culture background and construction land suitability, six aspects of the real estate industry as the impact of the project site.

On the basis of analysis of Xi 'an urban spatial structure, combined with the accuracy of the data collection and scientific principles, divide the factors into twelve geographic information elements.

We use G1 method to investigate factors affecting, and calculate the amended weight. Indicators grade and weight distribution as shown in Table 3.

In the space of neighborhood analysis, the intensity of influence on the body near the object distance increases linearly with attenuation^[5]. According to the characteristics of each factor, the scope of the provisions of the following: to plot near walk 0.5km there are bus station, the range of 1km in the subway station as the influence of traffic site boundary, the target area and the train station, airport distance as the closer the better; green land, park and scenic spot distance of 2.5km; the

distance between the plots and hospitals, the management committee of development zone and other public service agencies are the same; distance between projects and universities, research institutions no more than 3km; away from the central business district as close as possible, but does not include the business district; the nature of the land in accordance with urban planning requirements, in addition to exclude unsuitable building land according to natural geological conditions, but also need to consider the site protected areas. Due to differences in the scale of each evaluation factor distance parameter is large, and among some indicators have not comparable. Therefore, in order to meet the evaluation requirements dimensionless, the various indicators of processing, the quantitative expression of a unified standard. Scope of influence of the distance parameter is not used directly, but by various factors influence range of direct Euclidean distance are equal, and gives the corresponding grade value. In addition to construction land according to the local land are divided into 7 levels, the rest according to the Euclidean distance of the target of site selection are divided into 5 levels.

Table 2 Location decisions influencing factors

Influencing factors	Representative meaning
Traffic Conditions	Good external transport network can effectively solve the transport problems and the resulting need for internal commute
Ecological Landscape	Excellent natural ecological environment can satisfy the need of recreation, and the project is more vulnerable to consumers
Service facilities	Various policy resources and a complete set of Service facilities mature to promote coordinated development between enterprises and formation of industrial agglomeration
Social environment	Pursuit of life comfortable and cultural entertainment, reflect the high technology talents' selection tendency
Science technology environment and culture background	Recent intellectual resources, help enterprises to absorb scientific and technological personnel and high-quality workforce, promote the transformation of scientific and technological achievements
Construction land suitability	Greater flexibility and lower land cost of land in favor of value-added development project follow-up

Table 3 Space geographic factor classification and weighting

	Geographic factor	Grade interval	Weight
Traffic Conditions	Distance from the subway station	200~1000	0.0967
	Distance from the bus station	100~500	0.0992
	Distance from the train station	Euclidean distance	0.0739
	Distance from the airport	Euclidean distance	0.0645
Science Technology Environment and Culture Background	Distance from the universities	1000~3000	0.0874
	Distance from the scientific research institutes	1000~3000	0.0877
Service Facilities	Distance from the hospital	500~2500	0.0762
	Distance from the government public service institutions	500~2500	0.0951
Ecological Landscape	Distance from the park and green land	500~2500	0.0729
	Distance from the scenic spot	500~2500	0.0615
Social Environment	Distance from the business center	Euclidean distance	0.0821
Construction Land Suitability	Land use level	0~7	0.1028

3.2 Data Resource

The data in this issue come from Xi 'an city geographic information, including the position of the metro first to the fourth line sites, bus lines, train stations, airports, parks, landscape, hospitals, business centers, public service agencies, universities, research institutes and other elements, as well as rivers, mountains, ecological wetland and cultural sites, such as inappropriate. Administrative divisions from the state bureau of surveying and mapping, including seven administrative areas such as Changan Beilin, Xincheng, Lianhu, Yanta, Weiyang, Baqiao. Land use data vectorization obtained by Xi 'an state-owned land level diagram in 2012.Each element belongs to only single layer.

3.3 Spatial Analysis

This issue uses ArcGIS10.2 software Spatial Analyst toolbox and Spatial superimposed modules, such as some geographical elements in Spatial analysis. In order to make the results more accurately reflect the actual situation, all start with vector superposition analysis, finally for grid computing. In accordance with the scope and the weighting each layer to overlay and output different influence factors of single analysis diagram, as shown in Figure 1.

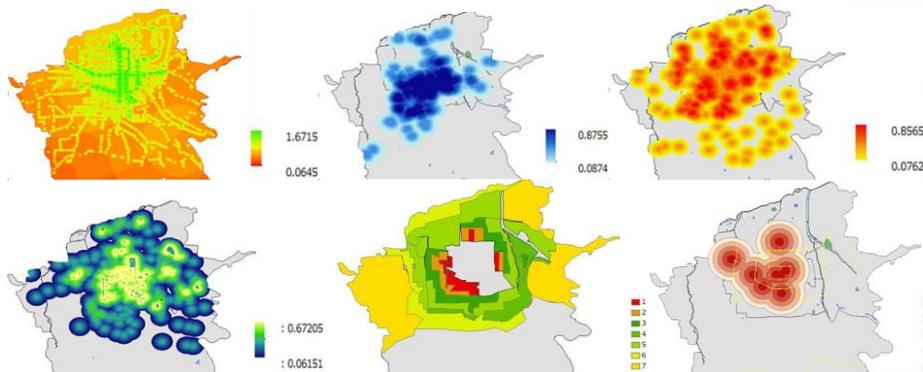


Fig. 1 The single factor analysis

The single factor analysis results are standardized grid processing with 26*26m for basic unit grid. According to the formula (1) for each single factor raster data layer above combined with weighted superposition. After deleting inappropriate area, output area of all land site Xi'an evaluation value of spatial distribution. As is shown in figure 2, the comprehensive evaluation value is between 0.06151 and 4.52435.

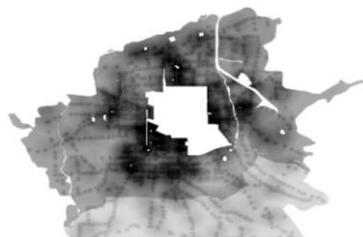


Fig. 2 Location of the spatial distribution of the evaluation value

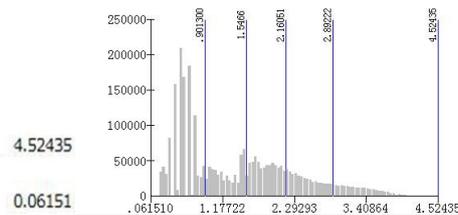


Fig. 3 the location value of population distribution and Jenks breaking point

According to Figure3, use Jenks natural breaks optimization to classify the overall evaluation, divided into five hierarchy.

Table 4 Comprehensive evaluation grade table

Development Area Level	Value Range	Area/km ²	Percentage/%
Level 1	2.89222~4.52435	161.72	8.37
Level 2	2.16051~2.89222	272.3	14.11
Level 3	1.5466~2.16051	403.26	20.89
Level 4	0.9013~1.5466	326.84	16.93
Level 5	0~0.9013	766.44	39.7

Range of values of the corresponding interval on the spatial distribution of the location value classification. Xi'an each block distribution of five space industry real estate location is in Figure 4.

As the statistical results show, level 1 of development area presents the concentric distribution around the town center, mainly concentrated in the east, north, southwest three directions, and further from the center of a structure presented radial fan outside introversion. Removal of restrictions on industrial zone of Xi'an urban area. Land area of level 1 is 161.72km², accounting for about 8.37% Suburbs are showing multi-core structure, characterized by relatively independent two area. In general, the above regional infrastructure, convenient transportation, beautiful environment, enrichment of intellectual resources, aimed at high-end preference for the construction of industry group.

Level 2 development area is around the level 1 of regional basic expand outward, mainly along the road to extend, also has two independent cores. With a total area of 272.3km², accounting for 14.11% of the total study area. Although the transportation more convenient there, and has the international harbor area and include comprehensive bonded zone, but the infrastructure is weak, less than the level one area. Along with the new type of urbanization in these region, coupled with the government's preferential policies to make these areas in undertaking industrial transfer, the development of urban industry has showing a great potential.

Level 3 of development area are close to Xi'an city scale, the area is 403.26km², 20.89% of the total land. industry development environment of Xi'an region is good, but its distribution is too scattered, difficult to promoting effect on the formation of industrial agglomeration, not conducive to the subsequent development of industry real estate project and its service industry.

Level 4 and 5 development area are 326.84 km² and 326.84 km², 16.93% and 39.7% of the total area of 5 zones. But its not satisfy the basic condition of project construction, no significance of location decision-making, can consider to rule out.



Fig. 4 Industrial real estate project site selection evaluation distribution

4. Summary and Conclusion

This issue has the following conclusion and revelation:

(1) According to the empirical results, the location value between 4.52435 and 0.06151, the level one and two for industrial real estate project development area accounted for 8.37% and 14.11% of the total area. The first two levels of spatial distribution of overall development area concentrated in east, north, southwest three directions in Xi'an, presented by concentric distribution near the city center, outward along the traffic lines radiating fan structure, and has appeared the trend of the center of the independent groups.

(2) This paper selected the industry of real estate project selected location decision factors such as traffic condition, ecological landscape, service facilities, science & technology environment, social environment, culture background and land suitability. On the basis of the rank of weight value, three geographical elements such as land suitability, traffic condition, development zones based on the top. It stands behind the land cost, transportation cost and policy resources and industry closely related to the location of the property.

(3)The real estate industry is a complex system. There are variety of forms in it. Its development is not only restricted by space constraints and construction conditions, but also need to consider the various factors. This article studies is only one aspect. In order to make a more scientific investment judgment, we should study with the method of cooperation, the right investment opportunity, project positioning, business mode, etc.

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