GIS Application on Land Appraisal

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Commission IV, Working Group 2

Keywords : Land, Economy, Urban, Application Modeling

ABSTRACT

Traditional land appraisal model analyzes impact components through factor analysis, cluster analysis, and regression model to build the relationship between influence factors and land price. Partial of that analysis did append the capability of computer aided power, but most of the data collection and manipulation still count on analog input which is not only process complicated but also time and labor consuming. Geographic Information Systems(GIS) can play an important role in efficiently extract spatial variables and lessen-labor and time input.

This study applied existing model as the criterion of land appraisal practice for Taichung city. The function such as buffer, intersect, and overlay from GIS technique were served as land appraisal simulation support. The model considered the width of adjacent road, distance to Central Business District(CBD), distance to grocery store, distance to parks and distance to displeased facility as the impact factors for land appraisal practice.

The result of this study demonstrated the improvement on the mapping and data input process. The average time saving and the enhancement of accuracy are the major outcome from this study since the GIS process reduce the possibility of human error and increase the exactness. If the cost of database building can be ignore, this GIS technique showed an economic incentive for land appraisal market.

Introduction

The principle objective of land appraisal is to levy a fair, reasonable, and acceptable price on land value. Due to limited land supply and rapid economic growth in Taiwan, dramatic changes have occured in the present land use pattern. Therefore, it is important and also difficult to conduct a good land appraisal .

In the traditional land appraisal practice, an appraiser uses his professional knowledge and experiences to evaluate the price of a parcel of land. He inputs influencial factors into a land appraisal model or formula to calculate the land price. The most important tasks in the appraisal procedure are data collection, manipulation, and analysis. Even recently, most of the procedures above still count on analog media inputs which are not only very complicate to process but also time and labor consuming. As the development of GIS techniques, it has made a great improvement in vector and raster data collection, manipulation and analysis. Consequently, to use GIS techniques will increase the feasibility and efficiency in land appraisal.

This study first selects a suitable land appraisal model through literature review, then applies it to land appraisal practice for Taichung city. The model selected considers the width of the adjacent roads, the distance to the Central Business District (CBD), the distance to the nearest grocery store, the distance to the nearest park and the distance to displeased facilities as the impact factors in land appraisal practice. Second, GIS techniques are used to input and manipulate graphical and attribute data. Third, it integrates functions such as measure, buffer, intersect, overlay, and shortest path in GIS into a land appraisal model to calculate and analyze the land price. Finally, it concludes this study.

Literature Review

There are many approaches in land appraisal, namely, market approach, cost approach, and income approach. Appraisers select appraisal methods depend on the specific goals and interests. No matter which approache chosen, the requirement of sufficient data is common to all appraisal approaches. For land appraisal, appraisers need not only professional knowledge and experiences but also accurate data in order to calculate a reliable price. Therefore, the key point to achieve a successful appraisal is how to collect, and analyze data efficiently.

For any appraisal model, there are all sorts of the influence factors. These factors can be classified into two categories, such as, social factors and physical factors. For the regional factor, most of the appraisal models consider as a social factor. Economic factor and political factor are also social factors. For the physical factors, most of the appraisal models consider the characteristics of the parcel of land (such as, area, width, depth, shape, location, and terrain), the adjacent to other land use type (such as, distance to transportation facility, distance to station, distance to grocery store, and distance to public facility), environment conditions (such as, public security, and social welfare), and land use conditions (such as, land use type, and land use intensity).

Due to the huge demand in data, it is very difficult to collect, manipulate, and analyze with the tradional appraisal models. Then, an appraiser can not have all the appraisal data required to condust appraisal. It is a great shortcoming of the traditional appraisal procedure. Consequently, the appraiser values the land largely by personal experience and the appraisal results are not objective. This is another shortcoming of the traditional appraisal.

Noting that the traditional appraisal methods are dependent upon people to collect and manipulate a large data set. However, with the help of a computer, appraiser now can easily manage the large data set, and analyze it with great efficiency. It also can build an appraisal model with regression equations. It lays the base of mass land appraisal.

The objective of the paper by Su zue-chui, Lin uion-sin, liu chin-chin (1977) is to find the variables affecting the land price. They found that the public facility, the land characteristics, the type of land use, and environment factor are important categories in determining the land price. They further showed that the distances to CBD, to the nearest grocery store, to the nearest park, the width of adjacent road and the distance to sewage disposal station are major factors.

Chung mei-inn in 「Building the Mass Land Appraisal Method Research」 collects the physical factors and regional factors from the relative appraisal reference and arranges it. She used correlation analysis, step regression, and time series analysis and constructed a land appraisal model with sixteen variables.

In this study, we use the model developed by Chung as the basic land appraisal model in this study. Next, we selects Taichung City as research area because it is convince to survey the physical conditions and to get GIS data of Taichung City.

The Model and Variables

The basic model of this study is adopted from "The Building of the Mass Land Appraisal Method Research" by Chung (1989). With adjustments according to the characteristics of the parcel of the land, the model can be stated as follows:

A. Land Price Function

$V1 = (Z1)$

$= (L1, I1, T1, E1)$

VI : the price of land ;

Z1 : a set of land attributes including conditions on land characteristics (L1), public facility (I1), public transportation (T1), and land use control (E1).

B. Land Appraisal Model

The land price is generated from the following appraisal function:

$$V = 12622 + 369.8X1 + 690.6X2 - 6.3X3 + 6.1X4 - 3.5X5 - 20.1X6 + 50.5X7 - 3.1X8 + 16.9X9 - 61.8X10$$

X1 : the depth of the parcel ;
X2 : the width of adjacent road ;
X3 : distance to bus stop ;
X4 : distance to the nearest long distance transportation station ;
X5 : distance to the nearest major road ;
X6 : distance to CBD ;
X7 : the degree of land use control ;
X8 : distance to the nearest park ;
X9 : distance to culture center ;
X10 : distance to the nearest college or university.

The integration of GIS and land appraisal

Generally speaking, the accessibility is one of the major factor influencing the land price. In this studying we use ARC/INFO to search and calculate the distance to the selected target for each land parcel. In addition, the system can also auto-catch the value of the distance variables, then bring it into the linear function to calculate the land price.

A. GIS analysis tools

(a) Topology and attribute analysis :

It calculates the area of the block and the land parcel, and analyzes the relation between the block and the roads adjacent to the block. It also calculates the bulk rate of the block.

(b) Relation data analysis :

Because block outline and the edge of the road are coincided, we can determine the roads adjacent to the block. After finding the center line of road, then we can get the widths of the roads which will be used as the basis for further analyses.

(c) Mathematical analysis：

It measures the vertical distance from each vertex of the parcel to the edge of the road. The distance to each selected target is measured accordingly.

(d) Overlay analysis：

It overlays the parcel with planning map in order to determine the exact location of the parcel.

(e) Buffer：

It is to analyze the nearest node to the parcel. The node is then used as the starting point in network analysis. The analysis uses the centroid of the parcel as the center and search for the nodes within a radius of 50 meters.

(f) Network analysis：

It is to analyze the accessibility of the parcel. It uses the center line of road as the base, then measures the shortest distance between the parcel and the selected target.

(g) Program writing：

It applies ARC/INFO AML to integrate and connect other analysis systems and to conduct mathematical calculations, such as, parcel depth, and regression.

B. Data Analysis

The data analysis procedure is shown in Figure 3-1.

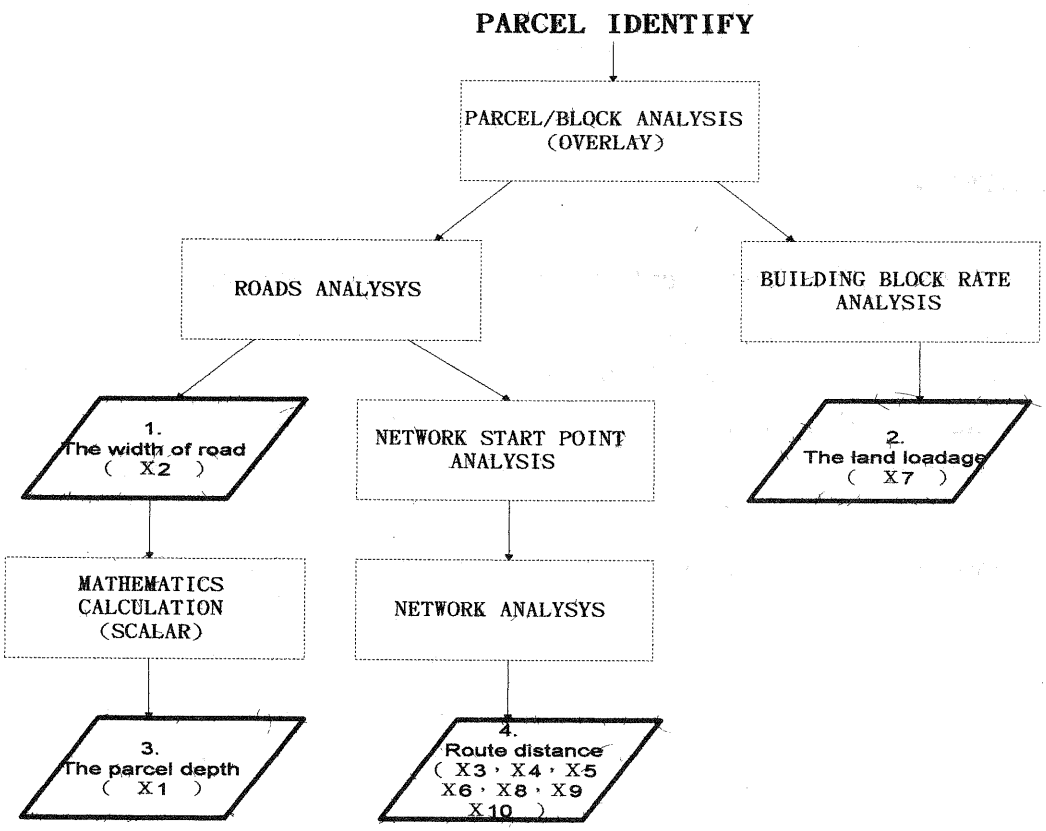

Figure 3-1 The data analysis

Conclusion and Suggestion

The result of this study demonstrated the improvement on the mapping and data input process. The average time saving and the enhancement of accuracy are the major outcome from this study since the GIS process reduce the possibility of human error and increase the exactness. If the cost of database building can be ignore, this GIS technique showed an economic incentive for land appraisal market.

First, in this study we apply GIS techniques to land appraisal. As indicated, it can automatically determine and measure the distance to the selected target. Consequently, it increases the efficiency and convenience in land appraisal. Second, it can further analyze the distribution of public facilities and transportation system reducing the demand of manpower. Third, it can provide a more accurate distance measure and reduce the possibility of human error.

Noting that there are many types of public facilities with different degrees of importance. Therefore, one may set different weights for the various public facilities in order to reflect the real importance. Next, in this study only the distance to CBD is considered. Since the function of the neighborhood commercial centers is increasing, it may have some impacts on land price. One may need to include the different layers of commercial centers into consideration in order to get a better estimate of land price.

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