

# **Producing a Land Valuation Map with GIS Using Nominal Asset Land Valuation Method: Case Study of Trabzon Province, Turkey**

**H. Ebru COLAK and Tugba MEMISOGLU, Turkey**

**Key words:** Land Valuation; Nominal Asset Land Valuation Method; GIS; Trabzon; Turkey

## **SUMMARY**

Land valuation has emerged as a result of the need to determine the cost of a land objectively and impartially. Satisfying of the need to accurately estimate the value of the land, it is possible to objectively evaluate and analyze the data used. In this context, many methods have been developed to determine the land valuation. Nominal asset land valuation method is one of the most important land valuation methods; it helps to provide more consistent information about the land in an accurate and fair way by using its environmental conditions, physical characteristics and relations with social-cultural centers. Besides being important this method, it is also important to process spatial and non-spatial data, to manage and organize the process, and to do all of this through an information system. Geographic Information Systems (GIS) is an important information technology that enables this process management to be performed in the most appropriate way. GIS as well as in many areas allows the realization of land valuation.

In this study, using the Nominal Asset Land Valuation Method, the land values located in a pilot area selected in the Kirechane neighborhood of Ortahisar district of Trabzon will be determined simultaneously and land value map will produced by using Geographic Information Systems (GIS). The fact that the Kirechane neighborhood in Ortahisar, Trabzon, developed rapidly between the years 2017-2018, and the rapid construction of the city in this region was effective in the selection of this region. In this study, factors such as proximity to the health center, religious facility, educational facility, slope, aspect, view, proximity to the residential center, proximity to the highway, land cover and parcel break points were chosen to be used as the main criteria for land valuation with nominal values. All these factors were weighted by nominal asset land valuation method and pixel based land value map was produced by using GIS. Finally, taking into account the purchase- sale values determined based on market conditions, the approximate value of each land has been determined.

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## **1. INTRODUCTION**

Land valuation is an important issue arising from the need to determine the cost of an object objectively and impartially not only in our country but also in many developed countries. In short, it is expressed as the process of determining an land in a certain time period by considering all objectively valid criteria as a result of various methods (Yomralioglu, 1995; Nisanci, 2005). Land valuation is taken as a basis in transactions in public service such as expropriation, privatization, development plan implementation, land consolidation, urban transformation, registration procedures and easement procedures. The Valuation Method is a process of appraising a carefully thought-out land with experience and judgment (Dale and McLaughlin, 1988) and in order to perform a good valuation process, it is important to identify and consider the general and specific factors affecting the real land value. In a valuation application, besides the properties that the land has, the location of the land is also very important. Because the value of the land, it is directly related to the properties and location information of the land (Yomralioglu, 1995).

There are many methods for determining the value of a land (Nisanci, 2005). In addition, the suitability of the method to be considered especially in valuation is very important. Generally, when examined land valuation methods are quite high in the literature. Some of those emerge as comparison (peer) method, income method, cost method, nominal asset land valuation method and regression analysis method (Yomralioglu, 1995; Yalpir et al. 2002; Aclar and Cagdas, 2008; Yomralioglu et al. 2012; Kocuturk and Kocuturk, 2015; Erdem, 2017). The selection of the most suitable for this method of land valuation varies according to many factors as to the location of the land, purpose of use, age, the nature of the land, etc. During the evaluation of the land value, many valuation experts can use different methods according to the region where the land is located and the distinctive features of the land and so the land value is determined.

Based on this information in this study, nominal asset land valuation method, one of the land valuation methods, has been taken into consideration. As the pilot region, the Kirechane neighborhood of Trabzon was selected, and the increase in value in this region was tried to be determined. For the study, the factors affecting the land valuation have been identified and the score criteria that these factors will affect the valuation have been determined through surveys conducted by experts. Then, using nominal asset land valuation method, the analysis was carried out using factors and factor weights, and as a result, a grid-based land valuation map of the region was produced. Later, sales values of lands that will constitute a precedent in the region were taken from land agents buying and selling and unit value map was produced. Finally, the parcel value maps of Kirechane Neighborhood have been determined by

overlapping with unit values and parcel areas. Thus, an exemplary application has been realized in which the values of the lands are determined easily and quickly with a holistic approach.

## 2. CASE STUDY

### 2.1. Study area

This study was carried out in the Kirechane neighborhood of Trabzon Province, Turkey. The reasons why the region is chosen as the study area; the region is an important point where the province has been developing in recent years, the region is an important point where people were heading towards these areas at the point of ownership acquisition and it will be given the zoning right in this area in recent years. Depending on these reasons, the fact that there has been an increase in land prices in this area in recent years has made it necessary to examine the value increase of the region and determining the real values of land has become important due to the income. Study area is shown in Figure 1 (Figure 1).

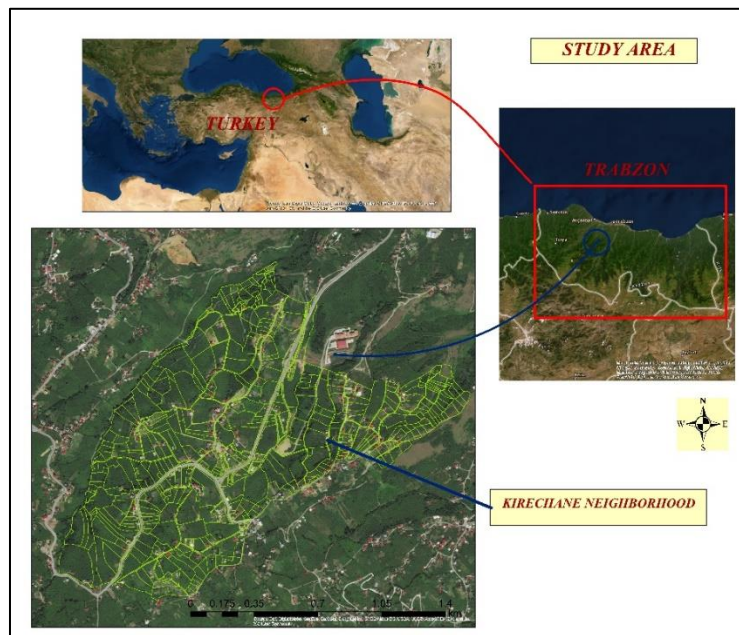


Figure 1. Study area

## 2.2. Nominal Asset Land Valuation Method

The nominal asset land valuation method is a method that deals with the holistic evaluation of lands owned. This method can easily reveal the distribution of value between lands, and this is achieved by formulating the criteria that affect the value (Nisanci, 2005). Nominal asset land valuation method, which is based on mathematical model and does not have many comments, can be effective in realistic results as it evaluates more than one criterion in the determination of the real land value (Nisanci, 2005).

In the evaluation of many land carried out in applications, market values are taken as basis. However, the units based on the valuation method used can change depending on the country's economic structure. These changes in market conditions, nowadays, it is difficult to keep the unit values on the lands under control. In addition, the areas to be evaluated are large and the number of lands is high complicates assessment to be made. Therefore, in the land valuation application to be carried out, it will be a realistic approach to determine real values with a holistic approach by considering more than one factor. Nominal asset land valuation method is an important method for this situation. The mathematical approach taken in realization of valuation in nominal asset land valuation method is as follows (Yomralioglu, 1993; Yomralioglu et al., 2012):

$$V(i) = S_i * \sum_{j=1}^k (f_{ji} * w_j) \quad (1)$$

In this equation; V represents the total nominal value, S parcel or pixel area, f factor value (points), w factor weight and k total factor number. This equation reflects the total value of each land. The variable “f” in this formula represents the factors affecting the real land value. “f” value is the effect of the determined factor on the land. The “f” point value can be between 1–10 or 1–100. In a pixel-based valuation process, each pixel has an “f” point value. Each factor affects the value of the land at different weights, and shows the weight coefficients as “w”. In the process of determining the factor values, it is assumed that each factor can take the maximum value of 100, therefore each selected factor is evaluated over 100% (Nisanci, 2005).

## 2.3. Determination of Land Valuation Criteria and Weights

After choosing the method and pilot region for the study, the criteria affecting the land value were determined. These have been identified as criteria that will affect the value of parcels, especially in the regional context, and also easily access spatial data from the relevant institutions. Besides that, with the thought of what different factors can be added to the detected factors before the implementation, the field studies of the pilot region were carried out, thus the availability of the determined factors was confirmed by providing preliminary tests. As a result, the criteria that will best represent the change in the land values of the region for use in the analysis are as follows;

- Slope
- Aspect

- View
- Land cover
- Parcel break points
- Proximity to the health center
- Proximity to the educational facility
- Proximity to the religious facility
- Proximity to the highway
- Proximity to the residential center

Later, determination of the weight of these determined criteria on the land value was carried out. For this, a questionnaire has been created that will be answered by academicians, institutional employees and private sector valuation experts who are specialized in land valuation. The prepared questionnaire was applied to 80 people and it was asked to score the criteria and sub-criteria that will affect the land value (Figure 2). Each of these criteria was scored between 0-100 for both criteria and sub-criteria by means of questionnaires applied to experts. Thus, the weights required for the nominal asset land valuation method were determined in accordance with the questionnaires conducted and arranged for use for analysis.

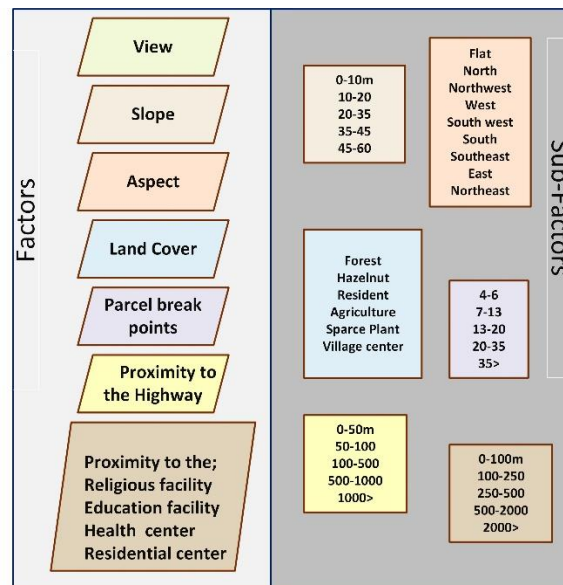


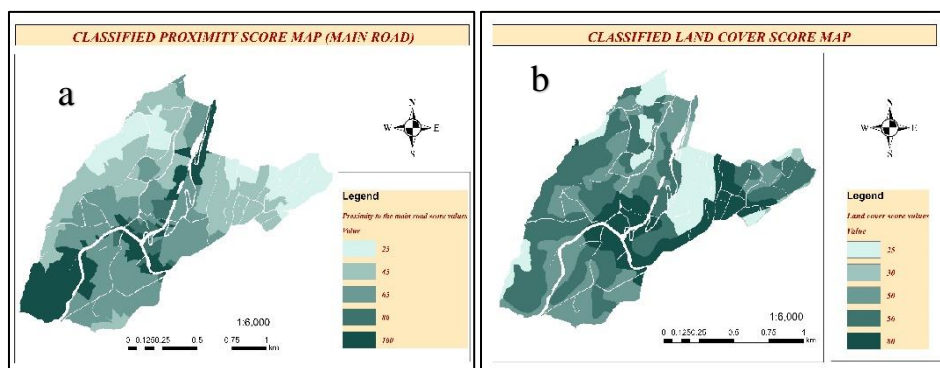
Figure 2. Land valuation criterias and sub-criterias

#### 2.4. The arrangement of the spatial data, geodatabase design and production of the land valuation map

After the determination of the weights for the criteria to be used, the stage of obtaining the spatial data of the criteria was started. In the acquisition of spatial data related to the factors affecting the real land value, some factor data were used directly, and some were taken from ready databases. Analyzes to be applied individually for each criterion serves as a step for creating and interpreting a nominal value map. Spatial data were provided in a single format, obtained from the KTU GISLAB Ar-Ge Laboratory, related institutions, and Google Earth

program and transferred to the geodatabase for use in analysis. Spatial data to the database prepared for the study was provided by first obtaining and transferring cadastral boundaries from the \*.dxf format via digital map data. Road data, land cover and residential data of the study area were obtained from the KTU GISLAB Ar-Ge Laboratory. In order to obtain slope and aspect maps, contour curves of the study area were also obtained from KTU GISLAB Ar-Ge Laboratory. For the breaking point data of the parcel, spatial data was obtained by automatically calculating the corner points over the cadastral parcels obtained from the Turkish Cadastre Directorate. The spatial data of educational facilities and health centers and religious facilities were marked on the Google Earth program and transferred to the geodatabase.

Geographic Information Systems technologies were used for the realization of the analyzes for this study and ArcGIS 10.6 software was used for the analysis to be carried out. After the spatial data was transferred to CVT, each data layer was converted to a raster format for analysis. Firstly, the slope and aspect maps were produced by classifying them using spatial analysis and combined with the weights obtained from the survey, a raster surface map was produced. For the view criterion, the cadastral parcel layer was taken into account the visibility status of the field studies conducted in the region and the opinion analyzes conducted on Google Earth, and a raster surface map was produced. Land cover data was grouped according to their classification factors and classified using survey scores and a raster surface map was produced. For the parcel break points criterion, survey scores were entered into the cadastral parcels again, the classification was performed, and a raster surface was produced. For criteria of proximity to educational facilities, health centers and religious facilities, walking distances are calculated in ArcGIS 10.6 software using the road layer starting from the middle point of each parcel, distance values were obtained, points were entered into the cadastral parcel, and a raster surface map was produced. The criteria for proximity to the highway and proximity to the residential center were determined by scoring again with the shortest walking distance and the surface map was produced. All surfaces were arranged in raster formats performed. The reason for this is that analysis, calculations and classifications on criteria can be made faster and easier with raster format. Raster surface maps classified according to the scores of all criteria were shown in Figure 3.




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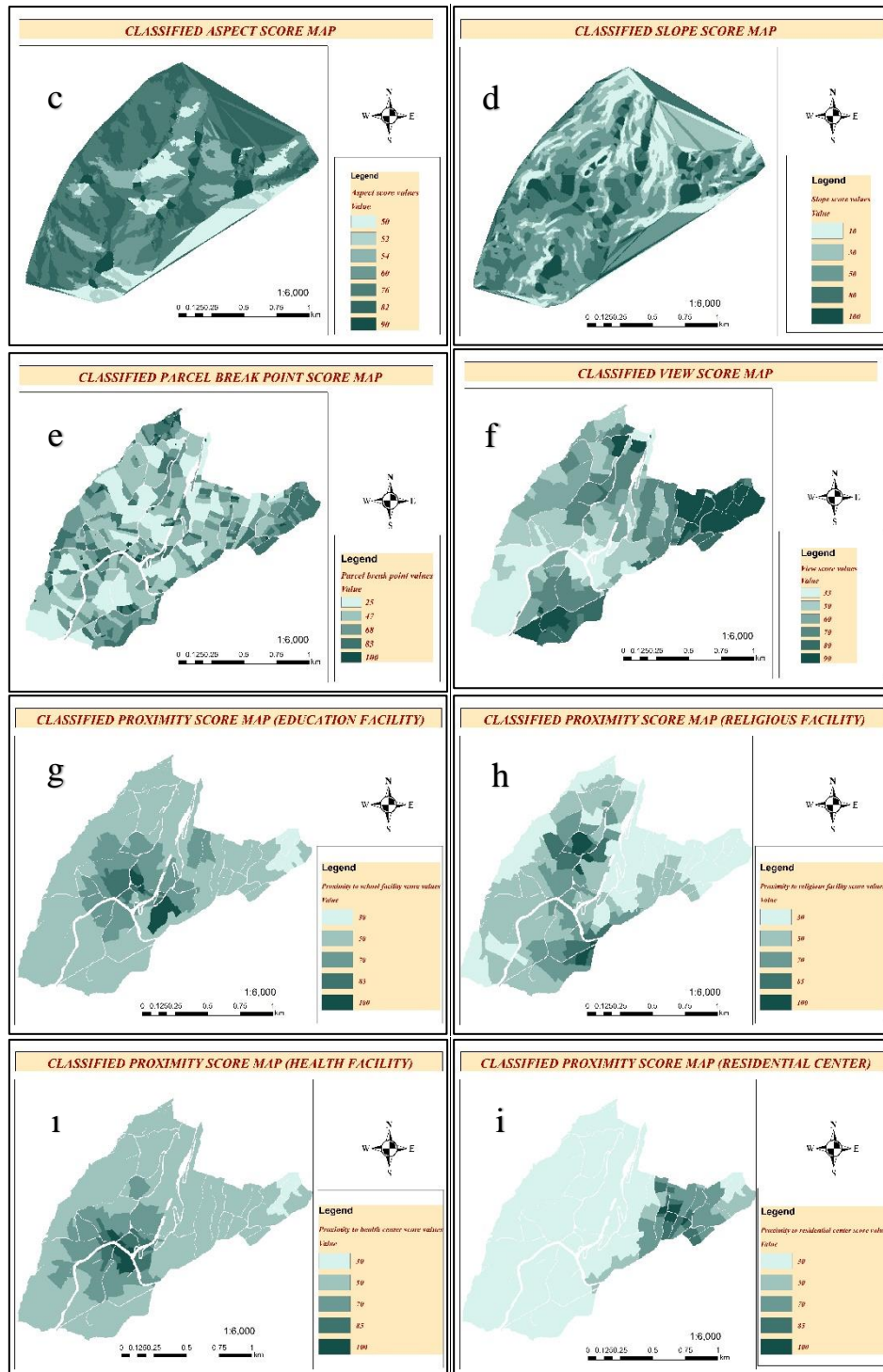


Figure 3. Classified raster surface maps

All raster surfaces obtained have been made to produce a single raster map with the raster calculator, taking into account the nominal asset land valuation method formula. Applied to

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the nominal value determination formula of the weights obtained from the survey results are as follows:

$$V(i) = \text{slope\_rc} * 0.13 + \text{aspect\_rc} * 0.09 + \text{parcel\_break\_points\_rc} * 0.12 + \text{view} * 0.12 + \text{land\_cover\_rc} * 0.06 + \text{highway\_rc} * 0.13 + \text{educational\_facility\_rc} * 0.08 + \text{religious\_facility\_rc} * 0.07 + \text{health\_center\_rc} * 0.08 + \text{residential\_center\_rc} * 0.11 \quad (2)$$

As a result of the analysis performed by applying the nominal asset land valuation method, an integrated raster result value map was produced. Immediately afterwards, this result was valued taking into account the actual market values of the map. The representation surface is divided into five classes to ensure that the value of the land is represented on a single surface with the raster surface map obtained. Actual sales values corresponding to each class were investigated and the peer sales values (Table 1) collected as a result of the researches were entered into separate classes for each class and the unit price values of the land were determined. Thus, Kirechane Neighborhood Unit Value Map was obtained on a grid basis (Figure 4).

Table 1. The market value of land sales

Class	(Turkish lira/square meter)
1	170
2	260
3	335
4	520
5	620

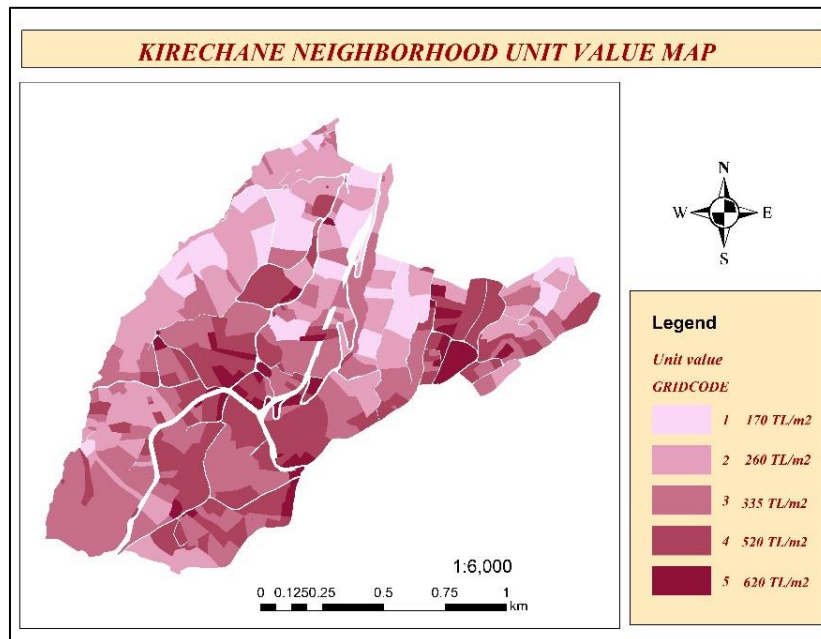


Figure 4. Kirechane Neighborhood unit value map

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The resulting unit value map gives information about “Turkish lira/square meter” of land in the region. However, to create parcel value map, the surface area of that land must be multiplied by the unit square meter value of each land. In this context, the unit value map was converted to vector data to represent spatial calculations. On the attribute table of the land, the unit square meter values are multiplied by the surface area of the land to which it belongs and the value information of each land is produced and this information is visualized on the map. Kirechane Neighborhood Parcel Value Map is shown in Figure 5.

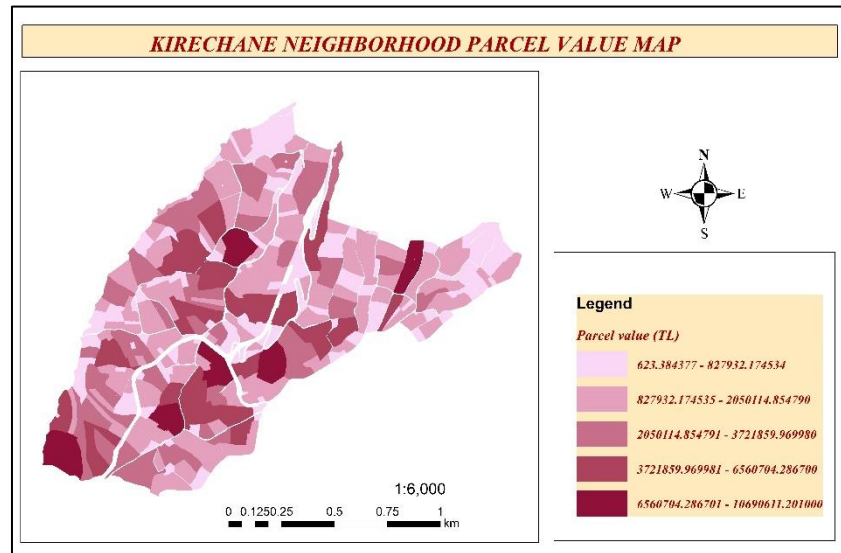


Figure 5. Kirechane Neighborhood Parcel Value Map

### 3. RESULTS

It is very important to realize the land valuation correctly for the country's economy. As a result of the fact that the land valuation cannot be made realistically, economic and sociological problems arise in many applications as property tax, expropriation, privatization, development plan implementation, land consolidation, etc. For this reason, land valuation must be made objectively. This is possible only if the land valuation is based on scientific principles. Today, the development of computer technology has made it easy to use complex methods with heavy burden of calculation. When the land asset valuation methods are integrated with GIS technology, the land values can be estimated with high accuracy in the light of objective criteria. Again, with the help of computer technology, the criteria affecting the land can be increased or decreased, and if necessary, the weights of these criteria can be easily changed. The important thing is to choose an appropriate land asset valuation method. Although it is impossible to reach real value, the method that approximates the truth the most and gives general information about the land to be sold is sufficient.

In this study, the valuation of land in Kirechane Neighborhood of Trabzon Province, Turkey was made using the nominal asset land valuation method. As a result, land unit square meter prices have been reached. Thus, financial information about that location can be provided over the unit prices of the desired region. Based on this information, it was observed that the

parcels with high unit prices did not stack up in a certain region. When the parcels are examined within themselves, the price difference is noticeable according to their location. This situation has concluded that the prices of the land occur due to the location where they are located and the factors used in determining the value.

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