

Introduction to Regional Planning Support Model of KOPSS

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ABSTRACT

Korea government has been developing KOPSS (Korea Planning Support System) to cope with the issue of sustainable development triggered by climate change. The REPSUM (Regional Planning Support Model) is one of five models of KOPSS. The REPSUM has four analytical components: The Regional Index Analysis tool diagnoses regional characteristics and issues with various indexes. The Regional Industry Analysis tool visualizes the spatial distribution of individual factories, analyzes a specialized function that identifies the spatial agglomeration patterns and evaluates the development potential of an industry in a region. The Regional Spatial Structure Analysis tool reveals spatial interaction among cities using trip data such as commutation and school attendance. The Regional Development Analysis tool visualizes what kinds of regional development project are implementing.

Keywords: Planning support system, Regional planning, Regional index, Regional industry

1. Introduction to KOPSS

Sustainable development is not any more a conceptual political declaration but an imperative strategy to survive. Spatial planning has great impacts on not only society and economy but also on ecosystem because it changes spatial structure and transportation. One way for sustainable development is to take into considering all information in the spatial planning process. Sophisticated analyses are inevitable as well.

The KOPSS (Korea Planning Support System) project (MLTM 2009) was launched in 2006 to cope with the planning issues. It provides analytical tools for spatial planning from national level to local level. Five planning areas are identified according to spatial planning hierarchy in Korea: Regional planning, land use planning, urban regeneration planning, public facility planning and landscape planning. Five models corresponding to the five planning domains have been developed using GIS technologies and various spatial analysis methodologies in response to the planning processes.

The Regional Planning Support Model (REPSUM) that is detailed in the following section provides information for regional planners. The Land Use Planning Support Model is composed of three main sub-models: Land Demand Projection Model, Development Potential Analysis Model and Land Allocation Model. The Urban Regeneration Planning Support Model searches for an area that should be revitalized based on the deterioration stage of buildings/houses, household density by parcel, the rate of irregular parcels and road length ratio by width.

The Public Facility Planning Support Model analyzes demand based on population by parcel unit for a facility and supply using a Probabilistic Gravity Model (Huff model). The Landscape Planning Support Model visualize a planned building in three dimension to explore the various aspects of the effects by analyzing skyline, visibility, average height, sunshine right, diagonal plane control, blockage ratio and facade area.

The KOPSS client was developed based on ESRI's ArcObjects. However, there has been strong demand for opening GIS engine so that an open API (Application Programming Interface) project has been implementing since 2009. As part of the development project, we are designing the open API to comply with the Open Geospatial Consortium (OGC) service standard (Figure 1).

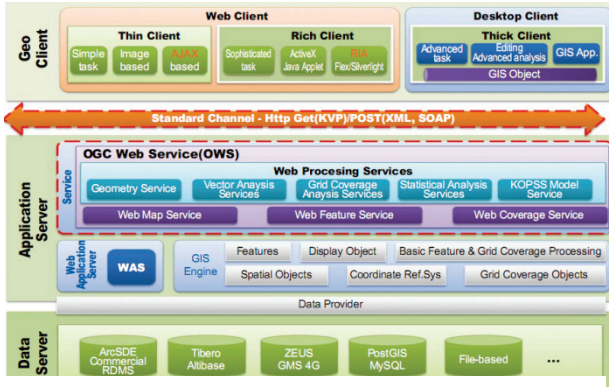


Figure 1 Open Application Programming Interface

2. REPSUM Overview

The main customer of the Regional Planning Support Model (REPSUM) is officers or planners in central and metropolitan governments, and provinces. They need a macro approach. They want to monitor the effect of their investment in terms of balanced development. They also wish to allocate their resources to local governments effectively within their jurisdiction. Accordingly, the functions of REPSUM have been developed to understand the relative development stage of regions, to reveal spatial interaction among regions, to identify industrial characteristics and to support balanced development.

The first component of the REPSUM is the Regional Index Analysis tool that diagnoses regional characteristics and issues using various indexes. There are over three hundred indexes. They can be classified into population, economy, industry and infrastructure. Some examples are shown in Table 1. The first step is to visualize an index at the level of local governments or at the level of metropolitan government/province. We can recognize the difference among the jurisdictions but it does not necessarily indicate whether the difference is statistically significant. In addition, we can present a scatter-plot of two variables with cross-tabulation analysis. The next step is then to analyze the local Moran's I (Eq. 1) (Anselin 1995). This gives us insight whether there is significant unbalance among regional development. Some more information can be obtained by analyzing the spatial clustering index, $G(d)$ (Eq. 2) (Getis and Ord 1992) and spatial segregation index, SI (Eq. 3).

Table 1 Indexes for regional planning

Category	Indexes for example
Population	Increase rate, density
Economy	Economically active population, local tax, financial independence
Industry	Area of industrial parks, Area of distribution complex
Infrastructure	Total road length, road area/person, rate of trunk road

$$I = \frac{n \sum_i \sum_j w_{ij} (y_i - \bar{y})(y_j - \bar{y})}{\left(\sum_i \sum_j w_{ij} \right) \sum_i (y_i - \bar{y})^2} \quad (\text{Eq. 1})$$

where n is the number of spatial units; y_i is the variable of interest; $\bar{y}$ is the mean of y ; w_{ij} is a matrix of spatial weights.

$$G(d) = \frac{\sum_{i=1}^n \sum_{j=1}^n w_{ij}(d) y_i y_j}{\sum_{i=1}^n \sum_{j=1}^n y_i y_j}, \quad i \neq j \quad (\text{Eq. 2})$$

where d is the distance of spatial extent. Other notations are same as in Eq. 1.

$$SI = \frac{x_i(d)/y_i(d)}{X(d)/Y(d)} \quad (\text{Eq. 3})$$

where x is the number of a variable in i spatial unit; X is the total number of the variable for whole area; y and Y are corresponding variable. The notation d is the distance that is determined by a researcher.

The Regional Industry Analysis tool visualizes the spatial distribution of individual factories and employee numbers that are registered on the FEMIS (Factory Establishment & Management Information System). We can choose a region and a specific industry type. It also analyzes a specialized function that identifies the spatial agglomeration patterns by LQ (Location Quotient). The LQ is spatially extended by incorporating a distance parameter d (Eq. 4). Finally, it evaluates the development potential of an industry in a region by investigating relative industries and accessibility.

$$\text{Spatial LQ} = \frac{x_i(d)/y_i(d)}{X(d)/Y(d)} \quad (\text{Eq. 4})$$

The Regional Spatial Structure Analysis tool reveals spatial interaction among regions using origin-destination data such as commutation, school attendance and business trips (Gwang-ik Kim, 2008). It is easy to understand how a region interacts with others because the tool displays trip volume by line thickness between regions. The Regional Development Analysis tool that is on the primitive stage visualizes the location of regional development projects by types.

3. Application

3.1 Index analysis

REPSUM provides a convenient way of searching, favorite or recent indexes as a table of context in the left side of the window (Figure 2). It also presents the attribute data in the right side. Figure 2 displays the population increase rate by local governments in 2008. Cities around big city such as Seoul in the upper left corner and Busan in the lower right corner show highest showing urban growth.

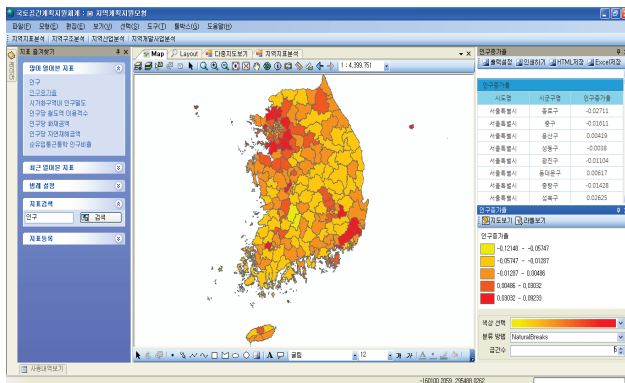


Figure 2. Population increase rate

Figure 3 presents an example of cross-tabulation analysis. X and Y axes indicate road area and local tax revenue, respectively. A small box of the scatter-plot in the upper left figure implies poor local governments with low local tax revenue and small road area. The selected local governments are highlighted on the map and then detailed information is presented on the table.

Figure 4 shows unbalanced development whether rich/poor local governments are clustered by analyzing Moran's I of the index of local tax revenue. Extreme values indicate spatial autocorrelation of the variable meaning unbalanced development. Figure 5 illustrates spatial clustering index of the same variable.

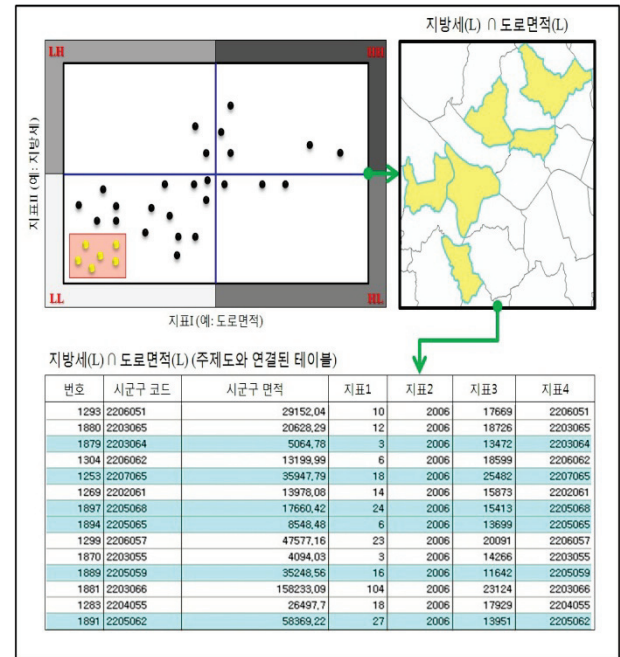


Figure 3. An example of cross-tabulation analysis

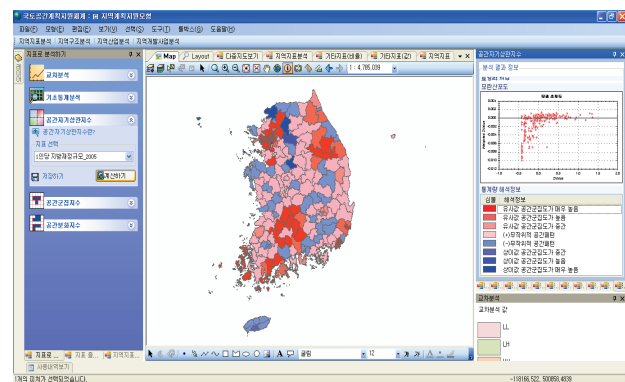


Figure4. Spatial autocorrelation analysis: Moran's I

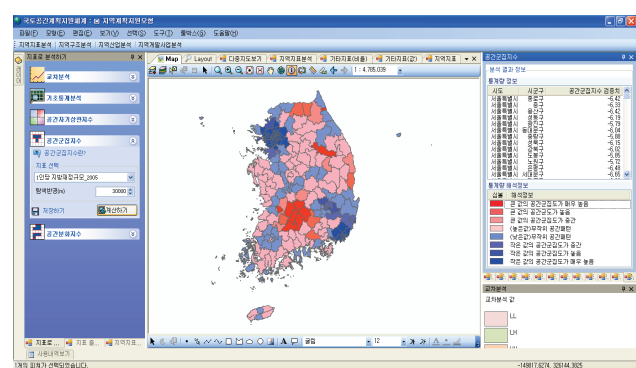


Figure 5. Spatial Clustering Index

3.2 Spatial interaction analysis

Figure 6 illustrates commutation trip volumes among cities. It reveals spatial interaction between cities implying separation of job and residence. School attendance and business trip volumes are also available.

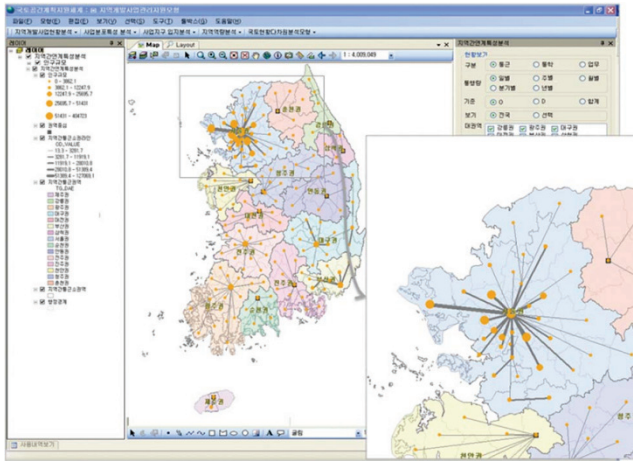


Figure 6. Visualization of origin-destination data

3.3 Industry analysis

Figure 7 describes an analysis process of industrial characteristics in Gyeongsangbuk-do province. First, the Regional Industry Analysis describes the count of factories for each minimal administrative boundary, Eup-Myeon-Dong, in the upper left corner. It is also possible to visualize them in a grid cell as in the upper right corner. Next step is to identify a specialized industry. The figure in the lower left corner illustrates the spatial location quotient with 10 km threshold. The last figure identifies the cluster of automobile and trailer manufacturing industry with the probability of confidence interval.

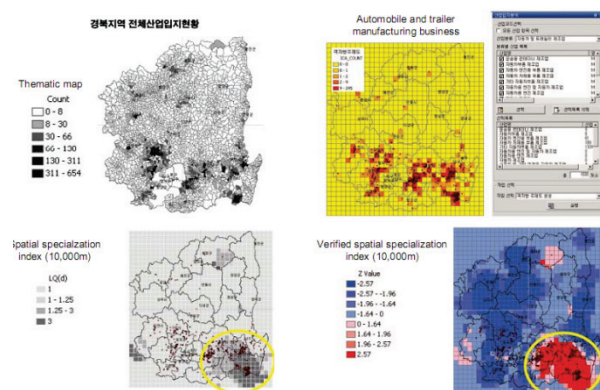


Figure 7. Industrial characteristics analysis

3.4 Regional Development Project

Figure 8 locates individual regional development projects. It also presents the attribute information of a selected project.

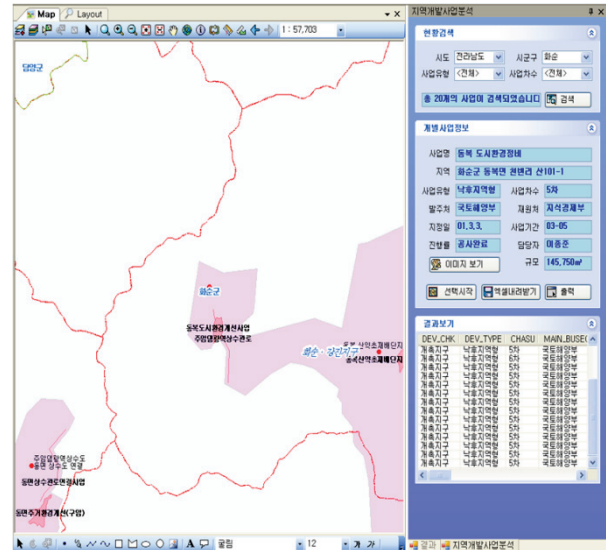


Figure 8. Visualization of a regional development project

4. Conclusions and Future Works

REPSUM has shown some possibilities as a decision making tool for regional planning. It visualizes current situation and statistically identifies unbalanced development using various indexes. It has also demonstrated that REPSUM can reveal spatial interaction among cities. Industry analysis has provided the type of industrial agglomeration in a province and regional development projects were displayed on map along with their attributes.

REPSUM is an evolving model headed for better decision making tool in regional planning. In terms of Plan-Do-See cycle, it needs to provide an avenue for planning, implementing and monitoring. A prospective monitoring for indexes with spatiotemporal pattern analyses to detect any significant change over time and a methodology to identify duplicate regional development projects are some of impending improvements in the near future.

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