The Journal of GIS Association of Korea, Vol. 15, No. 4, pp. 371-383, December 2007

The Strategies of Developing the Korea Planning Support Systems

Byong-Nam Choe* · Eun-Sun Im** · Kirl Kim***

ABSTRACT

The Korea Planning Support Systems (KOPSS) represent Korean style national policy and planning support systems using the GIS-based spatial analysis methods. The KOPSS refers to a kind of the spatial decision support systems (SDSS) or the planning support systems (PSS) for stakeholders' spatial decision-making. The KOPSS uses the existing individual databases obtained from the Architecture Information Systems (AIS) and Land Management Information Systems (LMIS) that have been constructed by information projects since the mid 1990s. The purpose of this paper is to suggest the development strategies and establish the theoretical frameworks of the KOPSS by considering the comprehensive basic composites of the GIS-based SDSS or PSS. For this, it deals with the basic concepts, the development strategies, the base environment strategies, and the promotion strategies of the KOPSS.

Keywords : Korea Planning Support Systems, SDSS, PSS, AIS, LMIS

요 약

국토공간계획지원체계는 지리정보체계 기반의 공간분석 기법을 이용하여 한국의 국토정책 및 계획을 위한 의사결정을 지원해 주는 시스템이다. 본 시스템은 일종의 공간의사결정지원체계 또는 계획지원체계로 정책결정가들의 공간의사결정을 지원한다. 국토공간계획지원체계는 1990년대 중반부터 구축된 건축행정정보시스템과 토지정보망에서 획득한 개별정보데이터베이스를 이용한다. 본 연구의 목적은 지리정보체계 기반의 공간의사결정지원체계나 계획지원체계의 종합적인 기본적 구성요소를 고려함으로써 국토공간의사결정지원체계의 이론적 틀을 설정하고 구축전략을 제시하는데 있다. 이를 위해 본 연구에서는 국토공간계획지원체계의 기본개념, 구축전략, 기반환

This paper was rewritten by reference to the proceedings of the 11th GIS International Seminar held in the KRIHS on October 24, 2007.

* Research Fellow, Geospatial Information Research Center, Korea Research Institute for Human Settlements (bnchoe@krihs.re.kr)
** Associate Research Fellow, Geospatial Information Research Center, Korea Research Institute for Human Settlements (esim@krihs.re.kr)
*** Associate Research Fellow, Geospatial Information Research Center, Korea Research Institute for Human Settlements (kirlk@krihs.re.kr)

경확보전략과 추진전략을 다룬다.

주요어 : 국토공간계획지원체계, 공간의사결정지원체계, 계획지원체계, 건축행정정보시스템, 토지정보망

1. Introduction

Korea central government has set up various spatial plans through the procedure of plan-do-see to construct livable national spaces. However, unpredicted errors in a spatial planning caused another problem. To minimize those errors and problems, it is necessary for the government to make the spatial decision support systems (SDSS) or planning support systems (PSS) that can analyze and solve the expected problems in the process of setting up the spatial planning [8]. The rapid growth in GIS-based spatial analysis technologies increases the expectation related to applications of information technology in the fields of the spatial planning. The various existing databases based on the Land Management Information Systems (LMIS) and the Architecture Information Systems (AIS) that have been developed since the mid 1990s also increase the expectation to construct the SDSS [1].

The Korea Planning Support Systems (KOPSS) refer to a kind of the SDSS or the PSS that provides the spatial information using various data and appropriate analytical methods in order to support reasonable spatial planning. The purpose of this study is to suggest the development strategy and establish the theoretical framework of KOPSS by considering the comprehensive basic composites of the GIS-based spatial decision support systems. The objects of this study are various spatial plans and national policies that the central government and local governments set up.

Literature review method was used to identify the theory and case of the SDSS. Advisory meeting was held to elicit the consensus of GIS experts. The semi-structured interviews with central and local governments' officials were performed to investigate the practical issues in relation to the spatial planning.

The KOPSS project started from 2006 and will be finished in 2010. The Ministry of Construction and Transportation (MOCT) provides the funds and the Korea Research Institute for Human Settlements (KRIHS) performs the project [8]. As the case study areas, four local governments participate in the project to reflect the opinions of practical requirements. The KOPSS development research committee is composed of the MOCT's relational team and local government officials. The KRIHS researches models with help of working group composed of spatial planning experts and the system development corporation has responsibility for the development of KOPSS models.

2. The Basic Concept of the KOPSS

The Framework Act on National Territory and the Act on Planning and Use of National Territory describe spatial policy and planning for the sustainable development of national territory. The purpose of the KOPSS development lies in the scientific support of spatial planning for the sustainable development. Thus, the vision of the KOPSS is to suggest the sound development of national territory, the promotion of Korean people's welfare, and the improvement of quality of Korean people's life (Figure 1).

To achieve the vision of the KOPSS, it is necessary to construct application systems and assure the strategy of base environment of systems. The application systems are sub-systems that deal with various data and knowledge in reasonable methods in order to elicit required information in the process of the spatial planning. They are composed of the user-oriented communication interface, the data management system, the model management system, and the knowledge management system in the perspective of system compositions. The base environment of systems refers to the platform that develops and operates application systems. Base environment strategies are divided into the platform, the integrated spatial database, the standardization, and the cooperation of system development.

3. The Strategies of Developing the KOPSS

3.1. The Conceptual Structure of the KOPSS

The various data and knowledge as input data can be treated by suitable analytical methods. The treated data and knowledge can elicit the information required to support a spatial planning. It can be represented as the process of a mathematical function with order

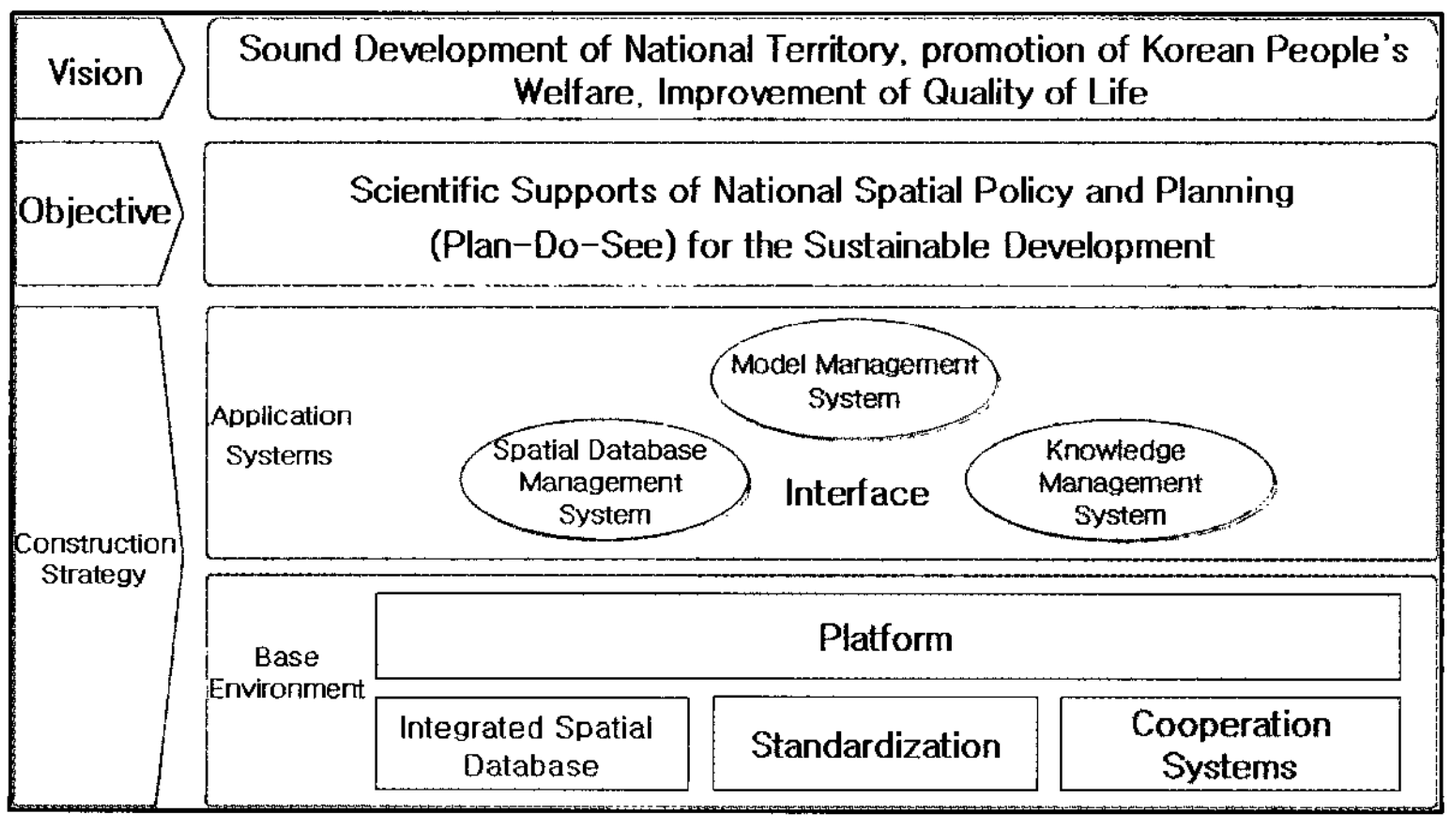


Figure 1. The Basic Concept of the KOPSS

of input-process-output (Figure 2). In terms of system, data and knowledge represent the input, and analytical methods refer to the process. The elicited information means the output. It is required to manage the data, knowledge, and analytical methods systematically to construct and operate the KOPSS effectively. For the KOPSS, the data management system, the knowledge management system, and the model management system should be constructed. In addition, the user interface should be constructed to elicit the information effectively and provide the treated results as a type of report.

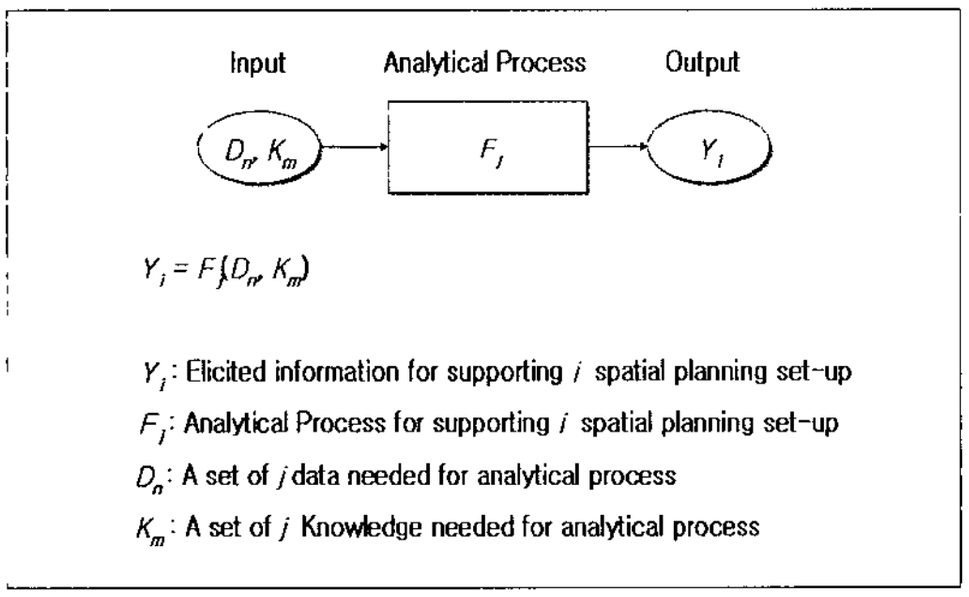


Figure 2. The Analytical Procedure of the KOPSS

The KOPSS is composed of four sub-systems including the data management system, the knowledge management system, the model management system, and the user interface. These sub-systems are application systems of the KOPSS. The application systems include platform[1)] that supports the construction and operation of the KOPSS (Figure 3). The development of the KOPSS means the construction of application systems using the development tool.

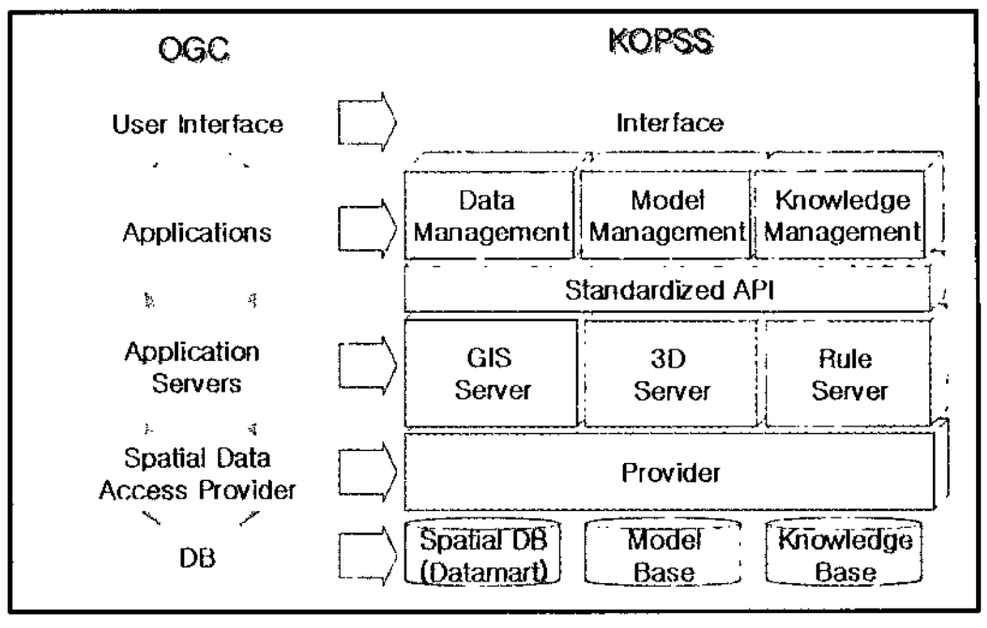


Figure 3. The Conceptual Structure of the KOPSS

3.2. The Strategies of Developing Application Systems: Sub-System Development Strategies

3.2.1 Data Management System

The KOPSS uses the existing individual databases obtained from the Architecture Information Systems (AIS) and the Land Management Information Systems (LMIS). Many systems have been constructed by information businesses for 10 years. Thus, the KOPSS needs to use the data obtained from the existing systems. The individual models composed of the KOPSS need the data management system that constructs the data mart of the KOPSS using database obtained from the existing other information systems (Figure 4).

The data management system should have functions that can elicit, synchronize, treat, and generalize data. It also should provide functions that treat, manage, and supply the data

obtained from the existing databases. The synchronizing function refers to one that harmonizes the update of data between the KOPSS data mart and the existing databases. The generalization means the function that continues to keep the scale of data.

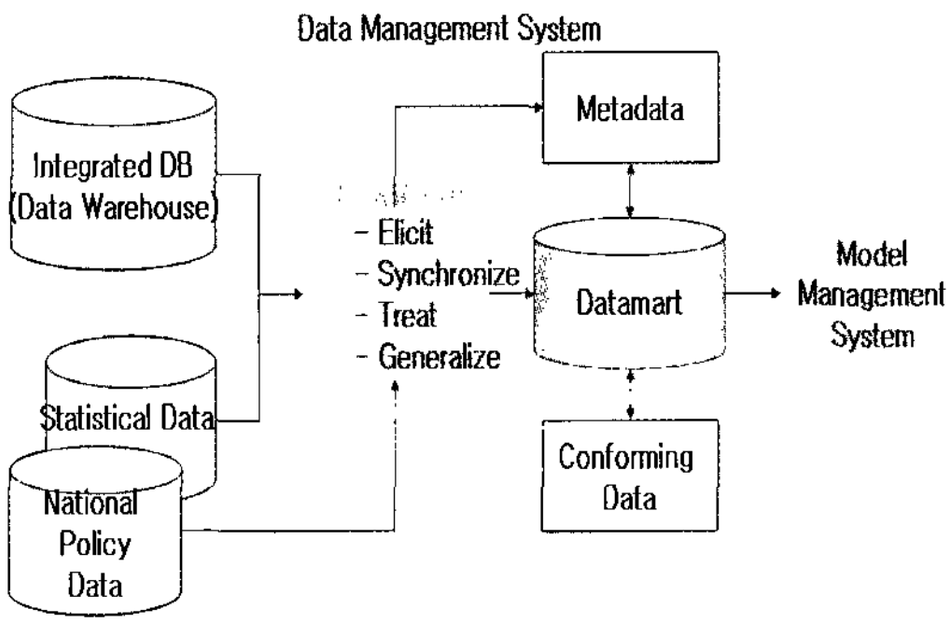


Figure 4. The Structure and Function of Data Management System

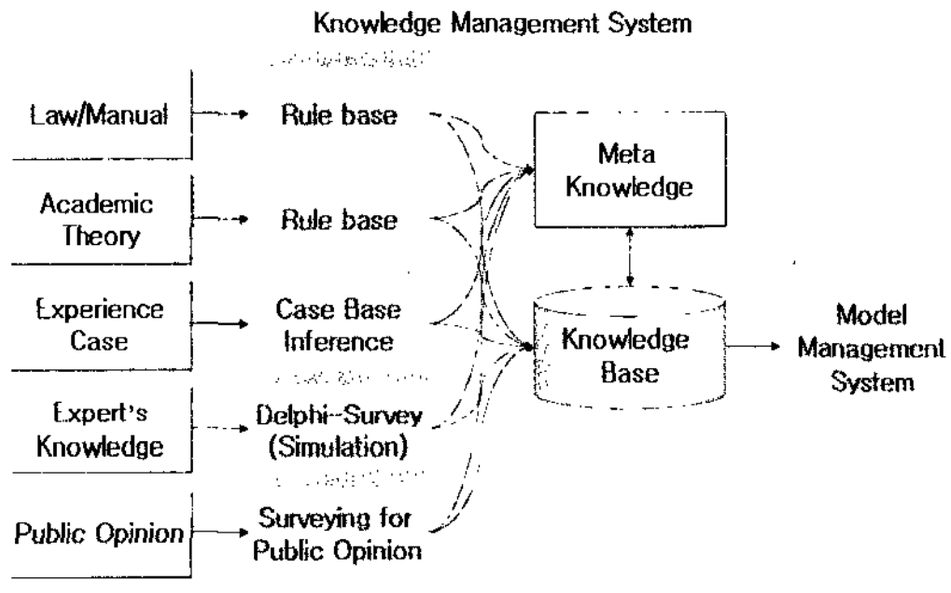


Figure 5. The Structure and Function of Knowledge Management System

The quality of the KOPSS data mart depends on that of the existing data. To keep the good quality of data, it is required to standardize the existing databases. The methods to conform the quality of the existing data include meta data analysis, topological relation analysis, and cross-comparison analysis. The next step is the cooperation between public institutions that provide their databases for the KOPSS. If we cannot know where the data are and how the data are used, we cannot construct the database. It is also necessary to set up the update-system to keep the good quality of data and consider the feedback system between the users and the systems. For this, the individual institutions with their own information systems should have common rules or standards in promoting the cooperation between the related institutions.

3.2.2 Knowledge Management System

The spatial planning is set up by the experts' knowledge, technology and experience. The experts' knowledge, technology and experience has a big effect on the spatial planning. Thus, the KOPSS should use many experts' knowledge, technology, and experience. The knowledge is usually used for evaluating the variables' standards or thresholds at the stage of each spatial planning. For this, the knowledge management system should be constructed in the KOPSS. The knowledge management system should systematize and objectify the experts' knowledge, technology, experience with valid methods, standards, laws, customs and practices.

The first knowledge to be managed includes laws, practices, customs, and academic theories systematized by rule-based methods. The second knowledge includes experiences and cases of the experts based on the case-based reasoning

methods. The third knowledge can be collected by the surveys and interviews with the experts. The last knowledge can be compiled by model analysis process of What-If system. In addition, participants' public opinions should be added in the knowledge. These knowledge has a relationship with development of collaborative spatial planning support systems.

However, it is also important to consider the experts' artistic characteristics in a spatial planning. In case the experts make a reasoning solution, they may not consider the creativity and artistic characteristics. Although many experts agree with the knowledge, there can exist alternative knowledge. Such a consideration of artistic knowledge will not be disregarded because the KOPSS has its role in supporting stakeholders' decision-making.

3.2.3 Model Management Systeml

The various data and knowledge as input data can be treated by suitable analytical methods. The analytical methods depend on the themes suggested and users. A user has his own option for decision-making. For this, the KOPSS should have various methodologies and manage them systematically. The model management system is a sub-system of the KOPSS that revises, renews, and manages the suitable methodologies and analytical methods

An analytical method can be represented as (Figure 6). The KOPSS calls it a LIBRARY composed of input, process, and output. The spatial planning has many stages of processes and its analytical procedure is performed by various methods. Thus, a LIBRARY means a methodology that supports the analytical procedure. A LIBRARY can be incorporated into a network of LIBRARY (Figure 7). In this paper, a network of LIBRARY can be defined as a COMPONENT. A component is composed of a number of libraries. A set of sequenced components becomes a task. Thus, information required for a spatial planning can be elicited and supported from a set of sequenced components.

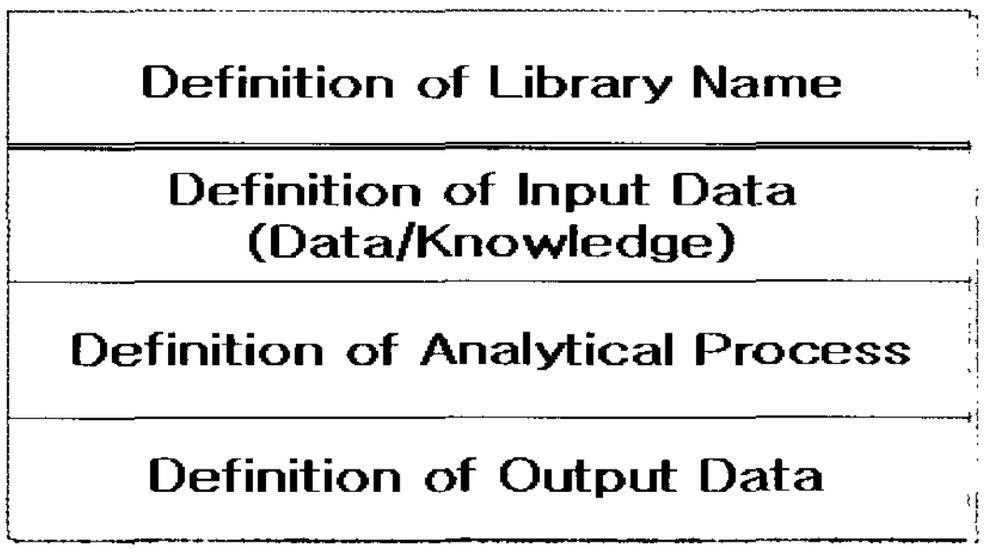


Figure 6. The Definition of a Library As an Analytical Basic Unit

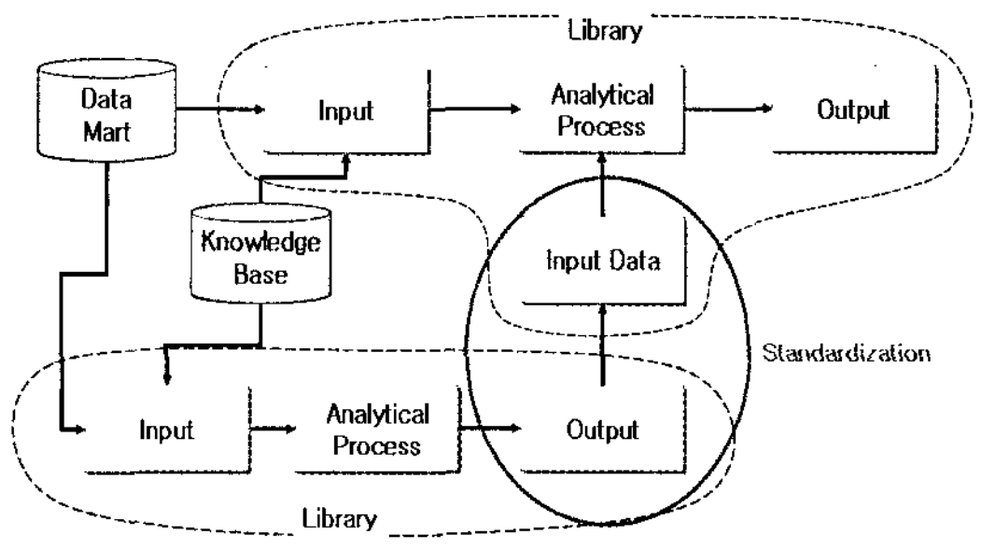


Figure 7. The Definition of a Component Corresponding to Analytical Process

Analytical methods have a huge impact on the results of a model. It is necessary to consider which analytical methods are suitable

for the solution. Thus, the development of a model can be achieved by the cooperation between the model developers and planners. A model should be constructed by the way that can provide the decision makers with various scenarios.

3.2.4 User Interface

Most spatial planning is conducted by the central government in Korea and is performed by professional institutions such as research institutes and planning engineering companies. The end-users dealing with the KOPSS are planning experts in the research institutes, planners in engineering companies, and central and local government's officials engaged in a spatial planning. The users depend on the scale and subject of a spatial planning.

The success of the KOPSS depends on the design of the well-made interface that can be easily used for the users. The interface of the KOPSS should be constructed by considering as follows: First, central and local government's officials are not computer experts. Second, the users are trying to find the most suitable alternatives. Third, the results should be easily understood for the officials. Fourth, the analytical procedure should be guaranteed by objectivity and transparency.

A spatial planning needs a high level of professional knowledge because it is a non-structured decision-making process. Thus, the development of the KOPSS avoids the automation of a spatial planning's analytical procedure and seeks for user-friendly system. For this, it is very important to consider the users' opinion.

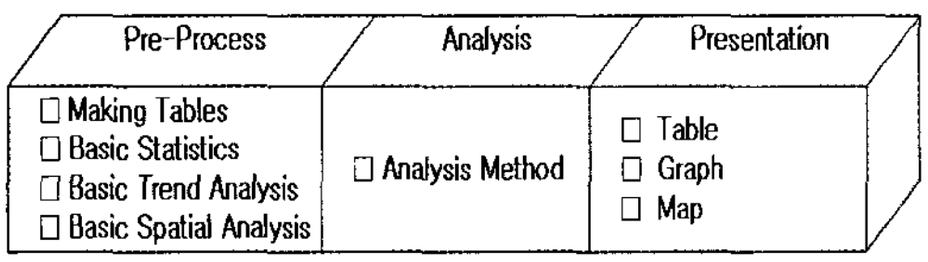
The user interface has multi-directional dialogue functions composed of menu and icons. Such an interface is useful to manage the variables, parameters, and analytical methods in the analytical process. The analytical results should include graphics, reports, and maps and be compared. Log files should be included to trace and identify the used variables, parameters, and analytical methods.

3.3 The Strategies of Developing Application Systems: Component-based Application Systems

Most spatial planning is based on a serial of task procedures. The task procedures are divided into a number of processes called "components[2]" and their processes are divided into a number of analytical methods called "library". This division is based on the concept of top-down. Inversely, in terms of bottom-up concept, planning scenarios as a task are incorporated into components. The task procedure follows the spatial planning process. Thus, component-based systems can reflect the spatial planning process effectively [11]. The KOPSS is being developed by component-based methods [10] and each component of the KOPSS is being connected into the standard interface. The component-based application systems are useful for the KOPSS's reusability, flexibility, and expansion.

The development procedure of the KOPSS

is divided into three stages (Figure 8). The first stage is the pre-process that has a role in incorporating input data. The second one is the analytical process that deals with input data. The third one is the presentation process that prints out the results of output. The presentation methods are visualized by a type of tables, graphs, and maps. A set of above three stages become a component and a set of components can be defined as a model or task (Figure 9).



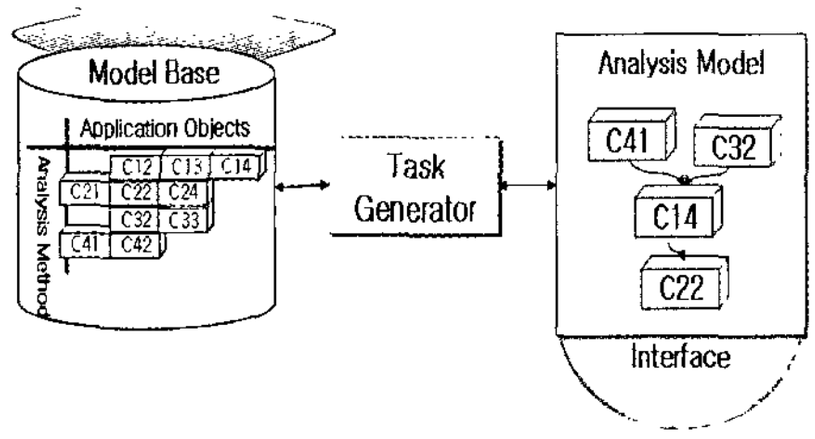


Figure 8. The Development Concept of Components of the KOPSS

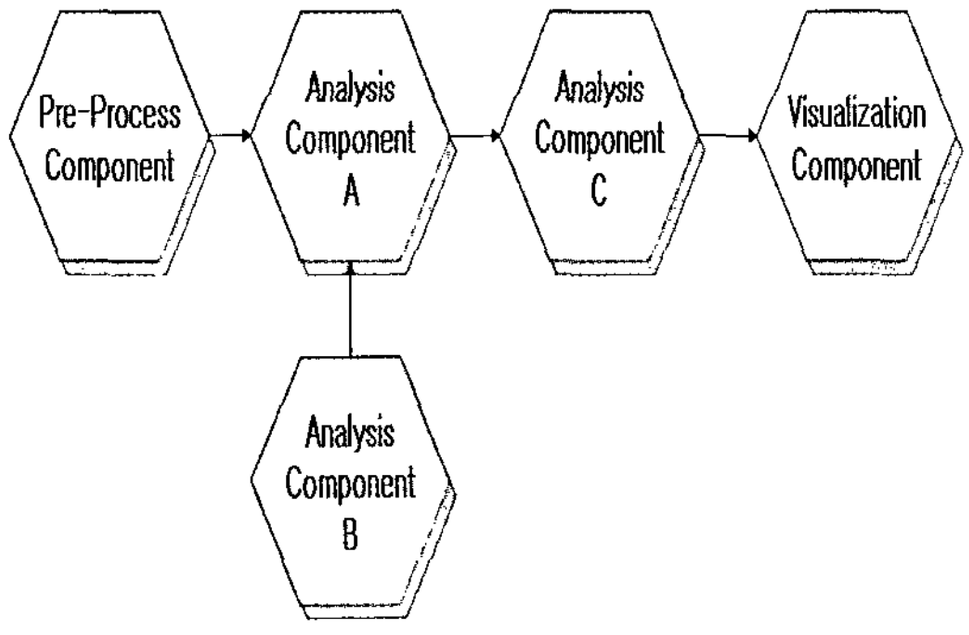


Figure 9. The Definition of a Model or Task As a Set of Components

4. The Strategies of Developing Base Environment

4.1. The Strategies of Development Tools

The choice of development tools is very important because the function of development tools has a huge effect on the implementation of application systems. The general strategy is to buy most suitable commercial products. The What-If is the most representative commercial product for a spatial planning [4]. However, the open source software such as UrbanSim [9] and MetroScope [3] is getting more and more as time goes on.

The development tools for the KOPSS should have the following characteristics: First, the KOPSS's platform should be a standardized tool to guarantee the interoperability[3] in different platform environments. Second, it should have a function to treat huge scaled spatial data by saving time. Third, it should be easily and conveniently made to correspond to the changes in rapid economic, social and technological environments. Fourth, the development tools should be developed based on future technological growth speed.

The introductory strategy of development tools depends on the criteria of selection. The domain I means that the development tools have the characteristics of safety and sustainability (Figure 10). The domain IV represents that the development tools have a huge effectiveness in terms of transparency, expansion, speciality, and cost. In particular, it is very

important to guarantee the openness that everyone can access in order to find out the suitable verification or error-monitoring method for the KOPSS. The KOPSS's development strategy of platform seeks for domain I and IV. However, domain IV's introductory strategy has a weakness in technical limitation and time consuming. Thus, in terms of safety and sustainability, the domain I will be more useful than the domain IV for the KOPSS. In current situation, it is necessary to consider step by step approach into the domain IV strategy by trying to make a R&D business and pilot project. When considering the domain IV, the KOPSS should not be a complete information system but a self-developed and flexible platform.

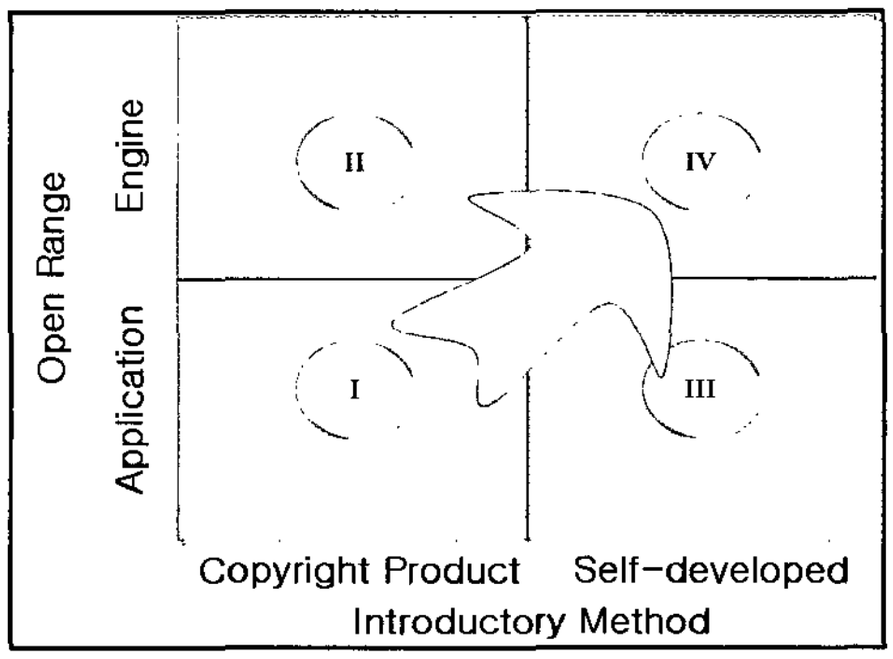


Figure 10. The Introductory Strategy of Platform Tools

4.2. The Strategies of Developing Integrated Spatial Database

The integrated spatial databases are a kind of data warehouse that stores a required information to respond the change of situation. If data for a spatial planning are constructed only by their needs, it will not catch up with the time of decision-making and it will be a cost consuming. Thus, it is necessary for the KOPSS to prepare for the standardized integrated spatial database composed of existing individual databases. The integrated spatial database is not only for the KOPSS, but also for the central and local governments and public institutes.

To maintain and provide the standardized integrated spatial databases, the central government should construct the National Spatial Data Infrastructure (NSDI) based on the Act on the Implementation and Utilization of the National Geographic Information System. The local governments should construct their own integrated spatial databases based on the standard of NSDI (Figure 11). The central government should construct the structure of the national information infrastructure that combines the local governments' integrated spatial databases by vertical and horizontal methods between the central and local governments. It

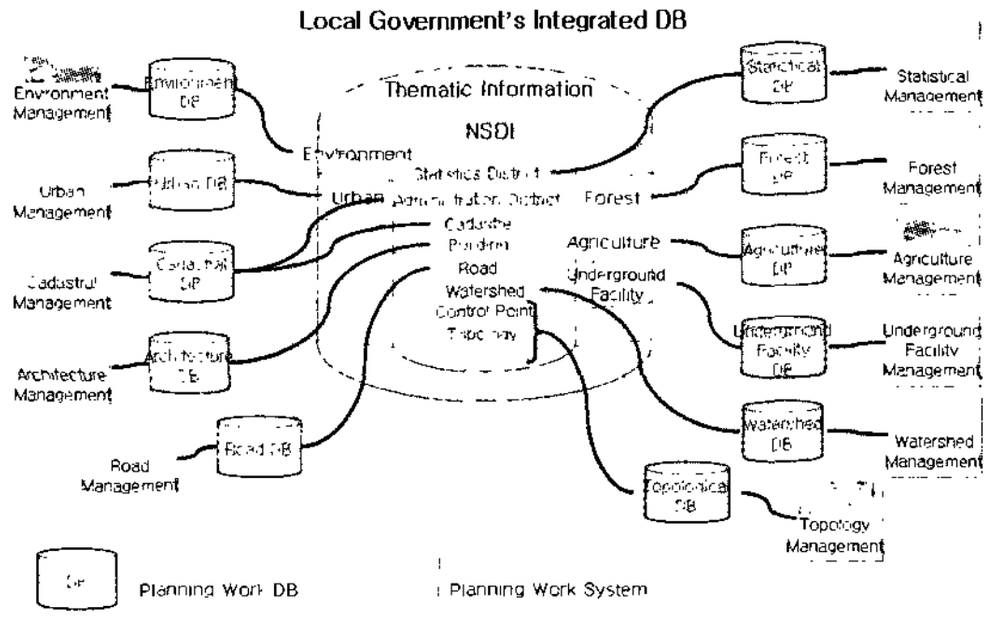


Figure 11. The Structure of Local Government's Integrated Spatial DB

also should construct the share system that everyone can access to the integrated spatial databases.

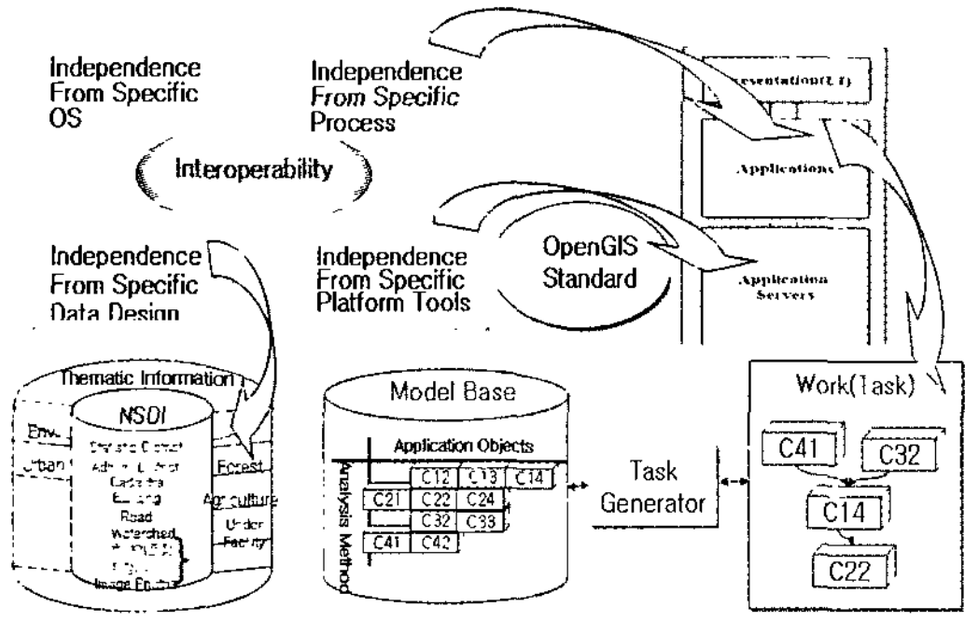


Figure 12. The Strategies of Standardization of the KOPSS

4.3 The Strategies of Standardization

The standardization of the KOPSS refers to a planned system that shares the information between different computer systems or performs the application programs. In the perspective of constructing the KOPSS, the objects to follow the existing standards are the operation systems, the GIS S/W (development tools), and the integrated spatial databases[4].

The development tools and existing developed commercial products should follow the standardization of the NSDI. In the fields of GIS, the international institutions such as Open Geospatial Consortium (OGC) and ISO are describing their standards. Most commercial products and open source software[5] are keeping the international standards. Current development and revitalization of open source GIS software is based on the standard infrastructure environment of GIS. The standard infrastructures of OGC and ISO have an advantage of linkage and reuse between open source GIS software and commercial products [5]. Thus, the development tools of the KOPSS should follow the standardized development tools.

The objects to need the standardization are the components of application systems in the KOPSS. The components in the KOPSS models need the standards to guarantee the interoperability. In other hands, we should keep in mind that the excessive share of information and the frequent interoperability between information systems will disturb the development of specific application systems.

4.4 The Strategies of Developing Cooperation System

The Korean central government has set up the spatial planning with the help of planning experts. However, there are many objections and demonstrations to set up a spatial planning. Although Korea has rapidly grown in social and economic aspects, the conflicts between participants who seek for interests and the phenomena such as Not In My Back Yards (NIMBY) are getting more.

To solve the conflicts and regional egoism, it is necessary to consider public participation in the stages of a spatial planning. In relation to public participation, there are many articles dealing with Public Participation GIS (PPGIS) [6][7].

The PPGIS uses the combination of spatial information-based tools composed of GPS, GIS,

and 3-dimensional model of aerial photos and satellite images. Citizens can suggest their opinion on the web or 2D/3D maps [2]. Such maps have an important role in supporting the exchange of information, analysis, and policy on urban space. The PPGIS makes the participants improve the access and share to spatial information using existing spatial information technology and GIT&S. The PPGIS is an informative and technological method that supports the participation of interest groups and achieves transparent and reasonable spatial planning set up. A spatial planning is differentiated by the purpose and stage of planning. The characteristics and roles of participants who take part in the planning are changeable. The participants can live in scattered areas or segregated areas and they may be planning experts. Thus, it is necessary to develop the KOPSS by considering the participants' characteristics and roles. The basic participation methods lie in eliciting participants' reasonable opinions by supporting and visualizing a variety of spatial planning scenarios. For this, it is required to block the digital divide. It is also necessary to block specific groups' intended participation by the introduction of log-in system. The KOPSS should consider the construction of the PPGIS that can collect various interest-participants' opinions.

5. Conclusion: The Promotion Strategy of the KOPSS

A nation has various types of the spatial planning. Thus, the objects for the spatial planning can be divided into entire city at a large scale and individual facilities at a small scale. The urban master planning dealing with entire city and national territory at a large scale will need the comprehensive simulation. Reversely, the urban facility planning at a small scale will need specific simulation for individual facilities. Thus, the characteristics of information systems depend on the objects for the spatial planning.

The purpose of the spatial planning can be divided into the specific problem-solving and the broad direction (management) for growth. The urban growth management is the long-term spatial planning for urban sustainable development over 10 or 20 years. However, the urban facility planning is the short-term spatial planning to solve the lack of facility. Thus, the characteristics of information systems depend on the purpose of the spatial planning.

It is necessary to consider that the spatial planning is not independent but interactive. A spatial planning has a hierarchical and interactive relationship with the other planning. Thus, the KOPSS should consider the relation between the spatial planning.

The purpose of developing the KOPSS is to provide the decision-makers with the required information to solve the problems caused by the incongruity between supply and demand of individual facilities. Thus, the KOPSS falls into the domain I (Figure 13). The domain IV is for the long-term urban master planning and needs the comprehensive

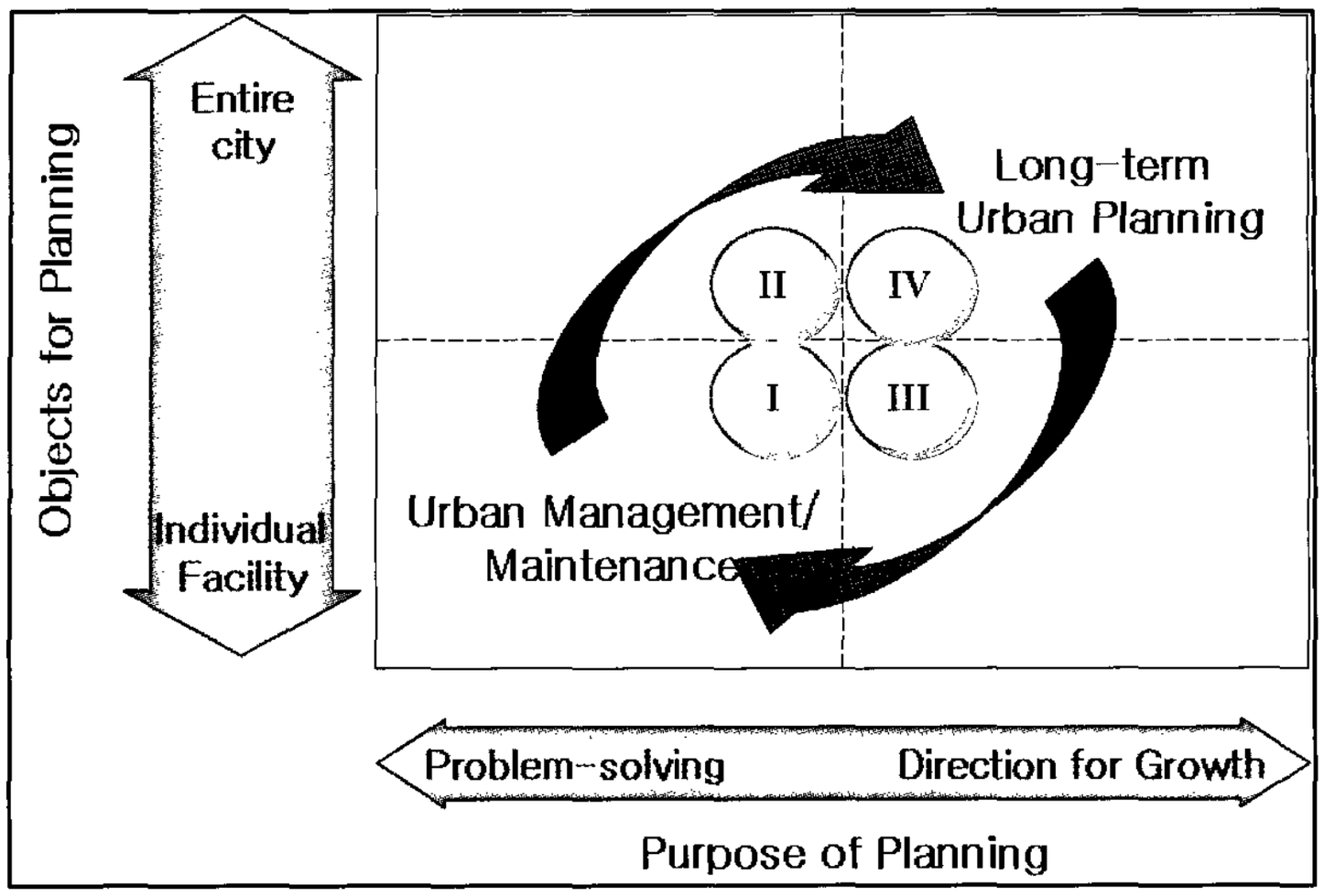


Figure 13. The Promotion Strategy of the KOPSS

simulation. UrbanSim and MetroScope will fall into the domain IV because UrbanSim and MetroScope are long-term and comprehensive simulation models for the metropolitan spatial planning.

The KOPSS will be developed into a long-term and comprehensive simulation model for urban growth management by considering the hierarchical and interactive relationship between the spatial planning. The KOPSS will be expanded and upgraded in terms of its function and capacity.

Endnotes

1) Platform is similar to application server, GIS development tool, and GIS engine regarding the structure of the Open Geospatial Consortium (OGC).
2) A component means the software's unit that users can combinate the composites at their intentions.
3) Interoperability refers to share of information between different computer systems.
4) The Integrated Spatial Databases should continue to follow the standards of the NSDI.
5) Open source software refers to the software that has open source codes of the program and can be distributed or redistributed freely.

References

Choe, B. N. *et al.*, 2007. A Study on Constructing National Policy Decision Support Systems. Korea Research Institute for Human Settlements: Gyeonggi, Korea.

Kim, E. H. and Park, J. G. 2004. "Public Participation GIS Service Design and Method,"

The Proceedings of the Geographic Information System Association of Korea. Fall. pp. 91-103.

Larson, K. 2000. "MetroScope: Simulating Future Urban Landscapes at the Parcel Level." The Proceedings of the Twentieth ESRI International User Conference. June 26. http://gis.esri.com/library/userconf/proc00/professional/papers/PAP626/p626.htm.

Lee, H. Y. 2005. "Searching for Applications of Urban and Regional Planning Support Systems." *Journal of Environment*. 43: 217-251.

Nam, K. W. *et al*., 2006. A Study on Developing the Manual of Constructing the GIS-based Standard/Open Source. National Information Society Agency: Seoul, Korea.

Rambaldi and Weiner, 2004. The Summary Proceedings of the "Track on International PPGIS Perspectives." Third International Conference on Public Participation GIS(PPGIS), University of Wisconsin-Madison: 18-20 July Madison, Wisconsin, USA.

Schlossberg, M, and Shuford, E. 2005. "Delineating "Public" and "Participation" in PPGIS." *URISA Journal*, 16(2): 15-25.

The Ministry of Construction and Transportation. 2006, 2007. A Study on the Korea Planning Support Systems. Seoul, Korea.

Waddell, P. 2002. "Urbansim: Modeling Urban Development for Land Use, Transportation, and Environmental Planning." *Journal of the American Planning Association*, 68(3): 297-314.

Yeh, A, and Qiao, J. 2004. "Component-based Approach in the Development of a Knowledge-based Planning Support Systems(KBPSS): Part 1: The Architecture of KBPSS." *Environment and Planning B: Planning and Design*, 31: 517-537.

Yeh, A, and Qiao, J. 2004, "Component-based Approach in the Development of a Knowledge-based Planning Support Systems(KBPSS): Part 2: The Model and Knowledge Management Systems of KBPSS." *Environment and Planning B: Planning and Design*, 31: 647-671.