

LAND SUITABILITY ASSESSMENT PSE DESIGN AND IMPLEMENT BASED ON WEB SERVICE

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KEY WORDS: PSE; Suitability Assessment; Web Service; Design and Implement

ABSTRACT:

Based on the construction strategy of PSE with Web service, the framework of land suitability assessment PSE is created, and a prototype of land suitability assessment information system is designed and developed partially. The land suitability of Huangpi district Wuhan city is taken as a case to test the prototype system, and the result shows that the method is valid and efficient.

1. INTRODUCTION

PSE (Problem Solving Environment) is a calculating environment, which is an integrated software system and problem oriented where data management, model and visual platform are constructed for certain problems. Watson (2002) brought forward that PSE is a new calculating pattern different from DSS and GIS, where a set of self-contained, convenient and high level toolbox is equipped for solving the domain problems. Since data and models needed by decision-making can be integrated in PSE, it becomes possible to discover and mine more knowledge and useful information from these integrated data, which are necessary for scientific decision-making.

Land Suitability Assessment is to evaluate the degree of land suitability synthetically for a certain land use type according to various physical, social, and economic properties. The assessing factors involved is comprehensive and across departments, and professional knowledge needed is across majors. For example, to assess the suitability of a parcel for wheat, those factors of soil quality, climate, hydrology, landscape, environment situation, local cultivation level and historical basis of agricultural development and so on are needed. These factors relate to multiple departments such as agriculture, weather, survey, environment and statistics. Consequently to get the influence of every factor to the suitability needs professional knowledge in multi-fields. However, in the traditional land suitability assessment process, the work team collects all departments' data and the result is achieved by consulting experts in all fields. Thus, on the one hand, it is difficult to collect data; on the other hand, there is no common platform for experts to communicate, which is disadvantageous for them to take part in simultaneously and leads to the low believable result. With the implementation of projects such as digital territory, digital agriculture, digital city and digital valley, every department constructs information sharing and communicating platform correspondingly, which makes it possible to realize the share of data and professional knowledge, and to resolve professional problems such as land suitability assessment and land use general plan effectively. Because so many researches on information sharing and interoperation across departments have been available and the

technology is feasible, this paper will take land suitability assessment as an example case to research and construct the PSE, which will provide land suitability assessment with a high efficient, integrated multi-domain knowledge toolbox..

2. PSE BASED ON WEB SERVICE

PSE can provide completed and convenient toolbox to solve problems in professional fields according to the requirements of problem domain, allowing users to define and revise problems, to interact with software and hardware resources, to determine the solving tasks and implementation schemes of outside problems. We can see that PSE is in fact a integrated calculating environment, which can integrate various resources needed by particular application through data mining and knowledge discovering, including sharing and integrating of data and field knowledge. Web service is regarded as a distributed calculating method for remote objects to work cooperating founded on web. Through web service we can link professional service or application to web to get network resources easily, to provide broad visits for application and trigger reusable application programs, which exactly meet the requirement of PSE. Therefore, this paper puts forward construction strategy of PSE based on web service. The core of PSE constructing graph based on web service include task management server and web service supply two parts.

2.1 Construction problem's solving strategy and task decomposition

he task management server is mainly to properly standardize the use's task requirement and match correspondingly the task resolving flow in the rule base of task solving schemes, to determine problem solving schemes and implementation processes after submitting user interactions, to discompose the aim of each process and give the description, input and output requirement of sub problem. The key is the rule base of problem solving strategy, which is the integration of professional knowledge. For example, the land suitability assessment task can be defined in the rule base as the following sub tasks: determining assessing goal and criteria→dividing assessing cells→selecting assessing factors

system→determining assessing factors→quantifying the factors and assessing single factor→synthetically assessing multiple factors→testing the result, etc. This rule base can be added by users using predefined adding method, and can also finish the input of rules at the beginning of base construction, then called by users and permit modifying.

2.2 Delivering, discovering and binding of web service

The main goal of PSE is to share professional resources and field knowledge of every department through integrated environment. One of its characters is taking a large number of professional departments as its supplier and delivering existed resources through network. At the same time PSE provides a tool to let the unit or department needing this service discover it quickly and set up effective link with it, e.g. , to realize the binding among requirement joints of service suppliers. We can adopt UDDI(Universal Description, Discovery and Integration) , a industry standard admitted by the large part of software supplier leading by Microsoft and IBM, to achieve this task.

3. PSE CONSTRUCTION OF LAND SUITABILITY ASSESSMENT

In terms of the requirements of land suitability assessment, on the one hand, it need integrate information from multiple departments as its assessing basis. On the other hand, it involves application of many kinds of models and methods. Therefore, PSE construction of land suitability assessment can share information of different departments and achieve integrated utilize related fields knowledge simultaneously, and can form a integrated problem solving environment.

3.1 PSE framework of land suitability assessment based on web service

On the basis of PSE construction based on web service and specific demand to land suitability assessment, PSE framework of land suitability assessment can be constructed as Fig. 1.

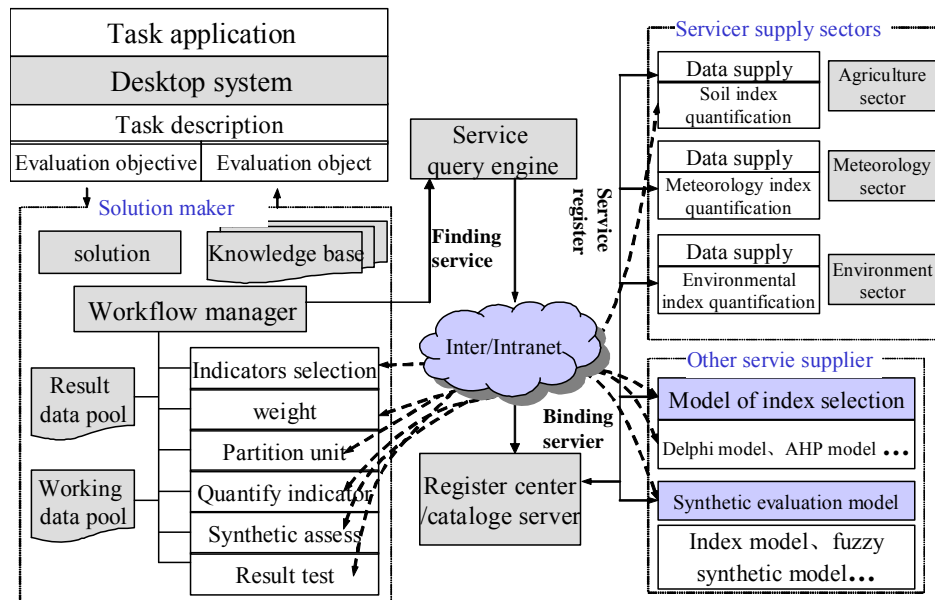


Figure 1. PSE framework of land suitability assessment

3.2 Key technologies of land suitability assessment PSE construction

We can see form above PSE framework of land suitability assessment that land suitability assessment PSE construction involves two key technologies, problem solving strategy rule base construction and maintenance of land suitability assessment and the discovery and bind of web service among related professional departments and service supplier.

3.3 Construction of problem solving strategy rule base land

The resolving strategy knowledge base of land suitability assessment is procedure knowledge set of solving procedure of land suitability assessment and its sub task division. It determines directly the implement efficiency and quality of land suitability assessment. In this research knowledge base is constructed by object-oriented technology, the rules are mainly related professional knowledge on land suitability assessment

business, the knowledge expressing model is described by formal logic describing method. Through the human-machine interface provided by system, field experts got the rule knowledge by interact directly with knowledge base, which is convenient to obtain the knowledge in knowledge base extensively.

The users bring forward task request of land suitability assessment through desktop system, including assessing goal, assessing object and so on. Then the task resolving scheme creator supplied by PSE standardize the task according to uniform description method, match this task with the knowledge base and search for the existed task resolving scheme on land suitability assessment in the knowledge base and a corresponding sub task set, and present them to desktop system to interact with users. If the users select one kind of these resolving schemes, the scheme is given to flow manager to manage and implement, or else the users can revise or re-define the task resolving scheme, and present them to flow

manager to go on, meanwhile this scheme will be saved to knowledge base as a new rule.

3.4 Web service encapsulation of land suitability assessment

The web service of land suitability assessment is mainly various models and methods used in assessing sub tasks, which is equal to functions provided by model base in single-machine environment, and the difference is that various model suppliers in PSE are distributed broadly in many professional departments and provide them based on web service. It is more advantageous to use that knowledge of different fields, integrating resources, and increasing work efficiency and result accuracy.

The models and methods of land suitability assessment mainly include factor framework selecting model of land suitability assessment, determining weight models, dividing methods of assessing cells, qualifying methods of each factor, synthetically assessing models and testing models. Factor selecting models and weight determining models may be Delphi, analytic hierarchy process, conjunction analysis and so on. Assessing cells dividing methods may be regular cells, dynamic cells, land using present situation parcels, administration boundary division and so on. Factor qualified method may be linear attenuation, exponential attenuation, overlay method and so on. Synthetically assessing methods may be fuzzy synthetically assessing method, index method and so on. Of course assessing synthetically can be done by others methods such as artificial neural network, trend surface analysis, discriminant analysis. These models and methods usually belong to different departments. In order to provide sharing service, UDDI technology can be used as following: (1) Discover web service; (2) Define the interaction method of web service on Internet; (3) Share web service information on a whole register table. Then delivering, discovering and binding of web service can be achieved. The API standard of UDDI programmer include two kind of API, that is, delivering API and inquiring API. Delivering API is used to register in operation entrance terminal or renew web service information. Inquiring API is used to discover web service in operation entrance terminal. Constructed web service can add related information web service to UDDI business register center to realize service network delivering, either through the web interface (handwork) provided by UDDI business register center, or by using programming interface tools described by API standard of UDDI, such as Microsoft UDDI SDK. After delivering service consumer can search for the service's description in UDDI register centre by inquiring and using API (or by handwork)

and gain the location information about corresponding service description document. Clients use this document to create a local instantiation object (equal to agency) to realize the binding between service and consumer.

3.5 Land suitability assessment flow grounded on PSE

The land suitability assessment grounded on PSE can be divided into the following several procedures: (1) The express of the problem. Given the formalized representation of problem to satisfy the demand of computer expressing and disposing, including the description of the objects of land suitability assessment and its aim needed. According to the system design, assessing object can be designated by a administration name, such as Huangpi District Wuhan City, or by its geographic coordinates, also may be a vector polygon of assessing scope. Assessing goal may be suitable for drought land, suitable for paddy land or other land use style like this. (2) The division of problem. The problem solving scheme creator provided by PSE divides the land suitability assessment task into a set of simple tasks, and present them to work flow manager to manage and maintain. (3) The solution of problem. The service query engine provided by PSE will look for the corresponding service, bind the service, bring forward the middle result and create the final result.

4. DESIGN AND IMPLEMENTATION OF EXPERIMENT SYSTEM

4.1 Experiment system design

The prototype system frameworks based on the PSE model are demonstrated as Fig. 2, including a desktop land suitability assessment system and a web service system. Desktop land suitability assessment system is wholly to call web service supplied by PSE through SOAP method by desktop application.

Service provided by web service application excludes data coverage, which just provides functions to dispose data. After the construction of application service (programs to supply models and methods), it can be delivered using two methods, one is to deliver directly and static, the other is to deliver dynamic through UDDI operation entrance spot supplied by Microsoft Company. When you adopt the second method, the constructed web service application requires its own independent URL. Thus static discovering strategy is adopted in the desktop system of this system when calling web service.

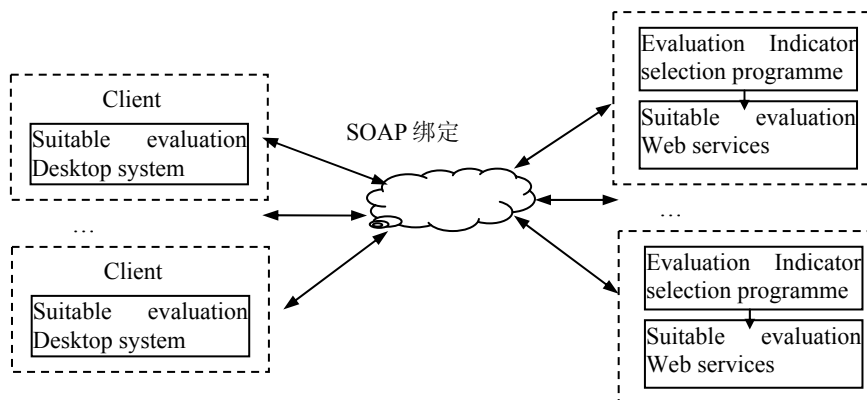


Figure 2. The logic framework of land suitability assessment system based on PSE

4.2 System developing strategy

The desktop system is implemented under Window 2000, taking ArcGIS 8.3 as its software platform, Oracle as its background database, and ArcSDE as its spatial database engine, using the internal VBA Macro language of ArcGIS and AO component technology to do the redevelopment. The web service supplier of professional departments are made up of web application (mainly .aspx page, .htm page and JavaScript small program) and web service application program (mainly .asmx page and .vsdisco discovering document). Thereinto partial functions of web application are supplied by calling web service application program. The experiment

system is completed in local network because of hardware limitation. The desktop system and web service system are located at different computer terminal respectively to stimulate PSE.

4.3 System functions

The module designation of desktop system is designed based on PSE and simplified thought, including data entering, data editing, land use present situation analyzing, land suitability assessing, thematic graph drawing modules and so on, demonstrated by Fig.3.

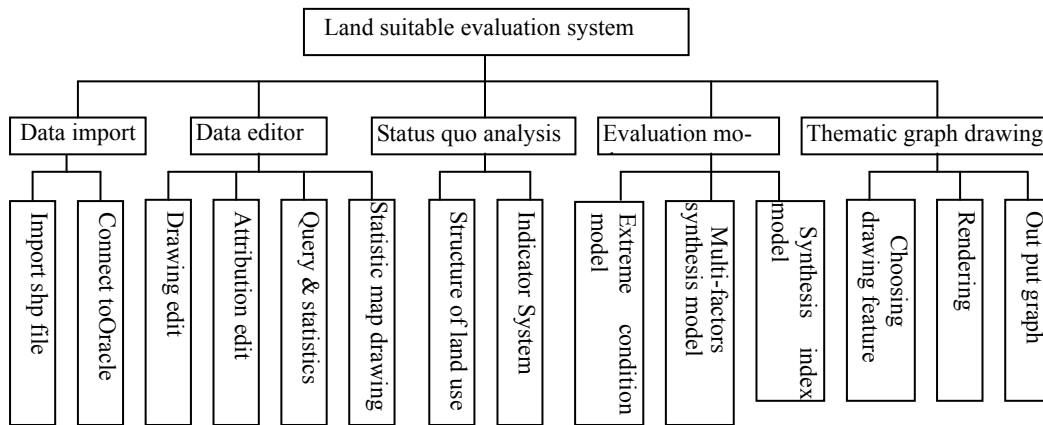


Figure 3. Modules of the land suitability assessment desktop system

With these function listed as fig3, this system can fulfill land suitability assessment grounded on PSE in local network environment, that is, obtain needed basic data (assessing working fundamental map, assessing factors chart) of land suitability assessment from different web service suppliers (agricultural, land, environment, statistics, professional departments and so on) and related professional models such as multi-factor synthetic model, extreme condition model and so forth of land suitability assessment to fulfill it.

5. CASE STUDY

This paper takes Huangpi District Wuhan City as the case, using above system to fulfill its land use present situation analysis and suitability assessment to test the effective of the models and system. Huangpi district locates in the east of Hubei province, where is dispersed with mountain, upland, plain and billabong. The soil is fertile, and the water resource and rainfall is plentiful, which fit for various land use.

5.1 Drought land suitability assessment based on experiment system

According to the land suitability assessment system grounded on PSE, the work flow is as follows: (1) Bring forward the land suitability assessment task, that is, the assessing goal is to assess the suitability for drought land, and the assessing object can be searched by the administration name of Huangpi District Wuhan City. (2) Through the match and selection interacting in the constructed land suitability assessment task resolving schemes knowledge base (the knowledge base is included directly in the desktop system in this research to simplify the simulation environment), problem solving scheme

and its sub task division are the following: selecting assessing factors→determine weights of factors→dividing assessing cells→quantifying assessing factors and assessing single factor→assessing synthetically, then the system presents this flow to desktop system supplied by flow manager to manage and maintain.(3) Get the assessing work map in terms of the description of task object.(4) Finding resolving models and methods for each sub task. For example, when qualifying the soil factor, overlay analysis method can be chosen. Searching for the service supplier of soil factor graph in PSE, and presenting it to service for overlaying to overlay, we will get the quantified result of soil factor. Single factor assessing of soil factor will be finished with the help of service supplier providing soil factor quantitative classifying method. (5) Seek and bind of service of synthetically assessing models. To simplify the experiment research, this experiment only provides weighted average method in one machine terminal to assess synthetically. The comprehensive assessing result can be gain under the classifying standard of synthetic assessment. The experiment system of land suitability assessment grounded on PSE and the assessing result are demonstrated as Fig. 4.

5.2 Experiment result analysis

The above land suitability assessment result conform well with the land use present situation of Huangpi District through contrast analysis of above assessing result and the actually land use condition of Huangpi District. This indicates that land suitability assessment result grounded on PSE is reasonable and accuracy. Moreover, we can see from above experiment procedure that we need not to collect data from every professional department to fulfill land suitability assessment under PSE, and can make full use of their professional

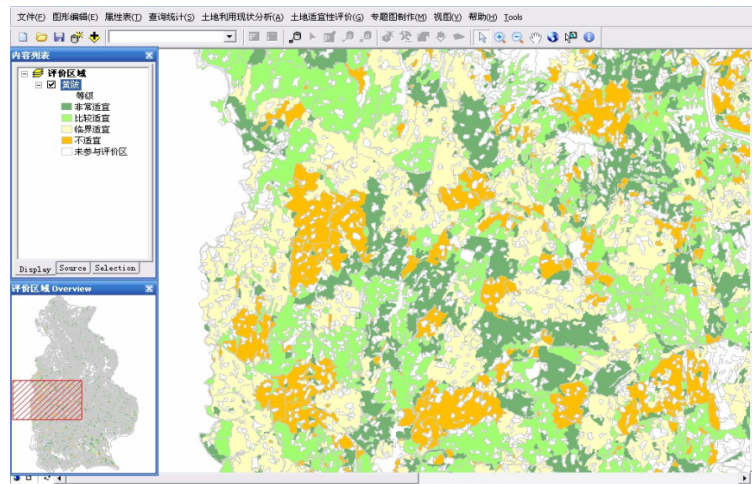


Figure 4. The prototype desktop system and the test result of paddy land suitability

knowledge and existed models and information outcome, which will avoid a large amount of duplicated work, realize the sharing and repeated using of knowledge, and improve the efficiency of land suitability assessment.

6. CONCLUSION AND SUGGESTION

6.1 Conclusion

Because land suitability assessment is a comprehensive work which need various kinds of basic data and involve professional knowledge of multiple departments, this paper research the land suitability assessment method grounded on PSE. The core research include the following:(1) constructing a PSE framework based on web service, which provide a uniform reference framework for related research.(2) investigating the land suitability assessment method grounded on PSE, designing a information system and developing it partially.(3)taking the land suitability for drought land of Huangpi District Wuhan City as a case, researching the feasibility of this method and the validation of the assessing result.

The experiment result shows that the land suitability assessment method grounded on PSE is a high effective method which can make full use of related fields knowledge and resources and follow the demand to the development of present land management and information society.

6.2 Suggestion

With the further development of network communication technology, how to realize the sharing and repeated using of knowledge in network environment and resolving specific field problem by integrating knowledge of multiple fields are challenges confronting to us in the time being. Even this paper brings forward a land suitability assessment framework based on web service, and proves it can do well in the local network environment, certain distance is still exist for it to be applied to actual application, the main problems are as follows. (1) It is difficult to satisfy the environment required by PSE integrated calculation. A uniform platform is absent for information between departments, including hardware platform, software platform of various standards, agreements and policies. (2) The land suitability assessment work lack normal workflow, which

bring difficulties to construct assessing methods base and knowledge base. (3) Research on data mining and knowledge discovering based on network are behind of the requirement of PSE application of land suitability assessment. Therefore it is difficult to discover and bind the web service of land suitability assessment.

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ACKNOWLEDGEMENTS

This research was supported by the National Science Foundation of China under Grant No.40701145 and the National Science Foundation of Hubei Province of China under Grant No.2005ABA228

