ISBN978-93-86878-09-0
11th International Conference on Management, Law, Economics and Interdisciplinary Studies (MLEIS-18)
Bali (Indonesia) Jan. 12-13, 2018

Development of WEB-Based GIS Model Traditional Knowledge in Indonesia Using Soft System Methodology (SSM) and Service Oriented Architecture (SOA)

Firdaus Muttaqinab[1] and Muhammad Salmana[2]

[1]Faculty of Engineering, University of Indonesia, Indonesia
[2]Department of Information System, University of Bengkulu, Indonesia

Abstract: *Indonesia has a wealth of traditional knowledge that is very diverse. However, this traditional knowledge is known by the local community who has such knowledge, so that it can not be controlled and monitored by the location of its distribution. So also what data is collected, the data processing flow and the organization that has the data is not known clearly. In addition, digitalization data of traditional knowledge is dispersed and stored in stand-alone systems. Therefore, data integration is needed to avoid duplication of traditional knowledge data. This study aims to analyze the situation and problem of digitalization of traditional knowledge in Indonesia and propose a model and architecture of web-based GIS distribution of traditional knowledge in Indonesia. Contribution in this research is try to combine approach used in this research is soft system methodology (SSM) and service-oriented architecture (SOA) approach to build web-based GIS and give recommendation of web-based GIS model of traditional knowledge in Indonesia.*

Keywords: *Web GIS, SSM, SOA*

1. Introduction

Indonesia has a wealth of traditional knowledge are very diverse, ranging from farm management knowledge, knowledge of food processing to knowledge processing of medicinal plants [1]. Traditional knowledge is delivered through oral tradition and has been successfully used for generations to support solve various problems and run the activities of daily living [2]. However, traditional knowledge is known to the local community has the knowledge [3], so it can not be controlled and monitored locations spreading. One way to simplify the control and monitoring of traditional knowledge is to perform digitization and mapped using a geographic information system.

Digitalization of data on traditional knowledge has been started by some parties [4], but what data is collected, the data processing circuitry and organizations that have such data is not known clearly. Analysis to determine a problem that is not structured and is not known clearly to do with various approaches [5], like a fishbone analysis, SWOT analysis, soft system methodology [6], etc. But according to [5], a suitable approach in knowing unstructured problems for system development that is soft system methodology (SSM). In contrast with fishbone analysis and SWOT analysis can only formulate a problem, SSM has the complete steps and produce a conceptual model of business processes of a problem that can be used to determine the features of a system [7].

In addition, data digitization of traditional knowledge is spread and stored in a stand-alone system. According to [8], [9] , the most suitable approach for integrating that data is with reference to the service oriented architecture (SOA). SOA approach has been widely used to integrate multiple systems domain, such as the health system, automotive systems, the education system ans others.

Research on the web-based GIS has been done by some researchers to solve various problems in various fields of science such as to make easier to manage and supervise the distribution of pesticides and plant diseases [10], to provide information on public services [11], the location of the distribution of historic sites [12], and dispersion prediction or forecast horticulture and horticultural production [13].

Based on studies from previous research, this study tries to develop web-based GIS that can be used to monitor the spread of knowledge of traditional approaches soft system methodology (SSM) to analyze the problems and the digitization of traditional knowledge and refer to service-oriented architecture (SOA) to data integrate traditional knowledge.

2. Research Questions

The research questions of this paper are presented below.

1. How to shape the model and architecture of web-based GIS using the approach of soft system methodology (SSM) and refer to service oriented architecture (SOA) for traditional knowledge in Indonesia?

3. Literature Review

3.1 Related Works

From the beginning of 2007, some of the researchers who conducted the research in the development of Web-Based Geographic Information System such as in 2007, Cha et al. conducted research on Geographic Information System distributed services from multiple vendors can be dynamically integrated into GIS applications using interoperable standard SOAP (Simple Object Access Protocol) [14].

Zhou and Wu in 2010 conducted a study for the development of Web-Based Geographic Information System to make it easier to manage and supervise the distribution of pesticides and plant diseases. ArcIMS and system development using ASP.NET [10].

Research Melville, Baker, and Dolly (2012) discusses the use of web technology in support of collaborative exercises that bring together agricultural practitioners, traditional knowledge and external experts. Utilizing volunteered geographic information (VGI) and participatory decision making at the ESRI ArcGIS platform [15].

Research Istikmal, Wibowo, and Yovita (2014) discusses the early stage development of a prototype application based information system Web-GIS for health centers that can help the community and the government in finding the location of the clinic, availability of health personnel equipment [16].

Research by Nama et al in 2015 discussed the development of Web-Based Geographic Information System to provide information on public services using the approach of the Unified Modeling Language (UML), among others, by using use case models, activity diagrams, and object diagrams and technology, among others apache2 web server, PHP5 programming language, mysql5 to the database server, and the Google API [11].

Research by (Santoso, Arham, and Khudzaeva) 2016 discusses the development of web-based geographic information system for the location of the distribution of historical sites. Developing a system using Rapid approach Application Development (RAD) and Unified Modeling Language (UML) [12].

Research by (Sulianta, Ai Rosita, and Laksana 2016) put through the research for developing a web-based geographic information distribution system prediction or forecast horticulture and horticultural production [13].

3.2 Traditional Knowledge

Traditional definition of knowledge is the knowledge possessed by the people or the local community about the fundamental aspects of carrying out activities of daily life, such as how to hunt, how to fish and how to manage food. Knowledge traditional has characteristic include local and original nature of a local community, is intangible, passed down through oral tradition, is based on experimental than theoretical, learned through repetition and changing constantly [17]

3.3 Web-based Geographic Information System

Geographic Information System (GIS) is a collection of computer hardware, software and data to manage, analyze, and display of geographic information form. Along with the development of internet technology, GIS evolved into a web-based GIS to facilitate accessing data at any time and whenever [18].

3.4 Soft System Methodology

Soft Systems Methodology, known as SSM is a suitable approach to know the problem is not structured for system development [5] which consists of seven phases [19]. Seven phases in the SSM can be seen in Figure 1.

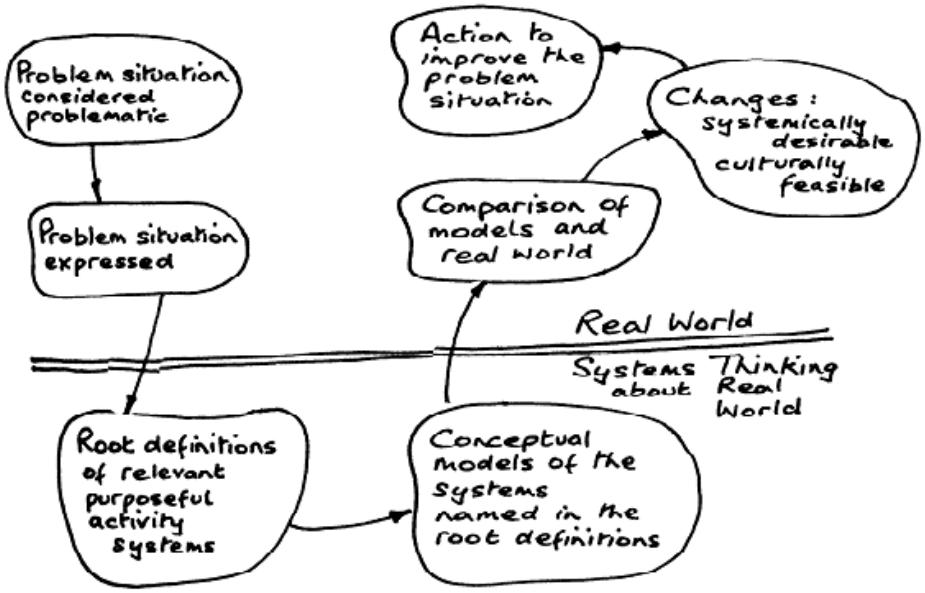

Fig.1: Phases of Soft Systems Methodology [7]

3.5 Service Oriented Architecture

Service-Oriented Architecture (SOA) is a solution in stand-alone system systems, such as functions and objects that can be termed "services" that are dynamic and dependent on interoperability [20]. Components of a stand-alone, loose service plus even complex business needs and dynamic environments of software systems can be integrated using SOA [21].

The concept of service-oriented technology that can provide communication providers and users in a manner. Web services are one way to implement SOA that can facilitate machine interoperability, such as REST web services and SOAP [22].

Components Web services with XML and easy connections. There are three roles of web services provider, requestor, broker. The role of the provider is to provide web services that can be used by the requestor, otherwise the requestor will utilize the web service, whereas between the provider and the requestor there is a broker that plays a role to provide a way of interaction between the two parties [23].

4. Research Methodology

Before doing the research to formulate a methodology as a research platform in conducting research activities. The methodology can be seen in Figure 2

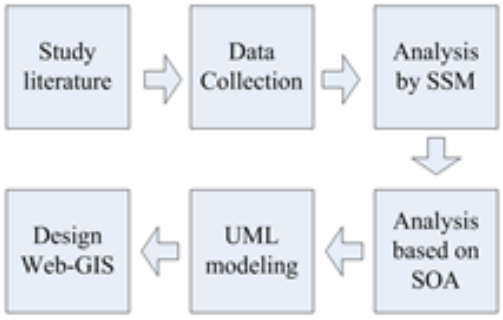

Fig. 2: Reseach Methodology

Based on Figure 2. This study consisted of six phase of the research include literature study phase, the phase of data collection, analysis phase with SSM, the analysis phase based on SOA, UML modeling phase, and Web-GIS design phase. Each phase solved using techniques or methods vary. A summary of the phases, activities, techniques and targeted the achievements of each phase can be seen in Table 1.

TABLE I: Reseach Methodology

Phase	**Activity**	**Result**
Study literature	• Conduct a literature study on traditional knowledge, soft system methodology, service-oriented architecture and unified modeling system • Reviewing research related o web-based geographic information system integrated.	• The literature review of traditional knowledge, soft system methodology, service oriented architecture and unified modeling system • Related work web –base geographic information system integrated
Data Collection	• Collect data related to the digitization of traditional knowledge in Indonesia • Interviews with expert researchers on the development of system integration and digitization of traditional knowledge	• The results of the study documentation • Transcribe interview
Analysis by SSM	• Analyzing the situation and problems of digitization of traditional knowledge in Indonesia	• Model situation and the problems of traditional knowledge in Indonesia
Analysis based on SOA	• Analyzing the architecture of traditiona knowledge systems in Indonesia based on SOA	• Architectural model of traditional knowledge systems in Indonesia
UML modeling	• Modeling web-based geographic information system integrated tratidional knowledge in Indonesia in the form of UML	• Model web-based geographic information system of traditional knowledge integrated
Design Web-GIS	• Develop a prototype web-based geographic information system integrates traditional knowledge in Indonesia	• Prototype web-based geographic information system integrated traditional knowledge in Indonesia

5. Result

5.1 System Implementation

In the interface implementation phase, system design and design is implemented using PHP programming language. Here is a list of layouts in Table 2

TABLE II: List of Layout

No.	File Name	Description
1.	login.php	Layout for login menu
2.	dashboard.php	Layout for dashboard menu
3.	caripenelitian.php	Layout for plant data search menu based on the research title
4.	tanaman.php	Layout to add and edit plant data
5.	famili.php	Layout to add or edit plant family data

When the first system is opened, the user is prompted to enter the username and password correctly so that it will appear dashboard form which contains the login user name and map of Indonesia.

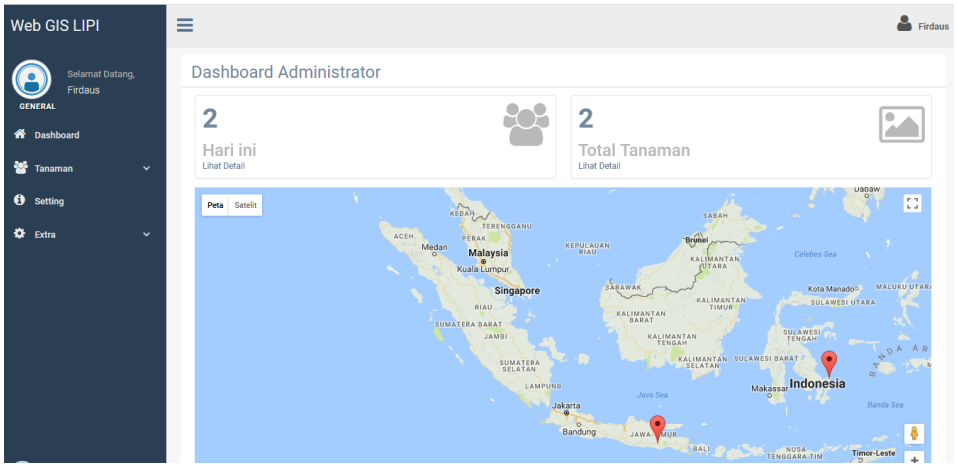

Fig. 3: Display of Dashboard Menu WebGIS

After selecting the menu collection of plants, the plant data collection form will appear with the action in the form of add, edit and detail as in Figure 4 below.

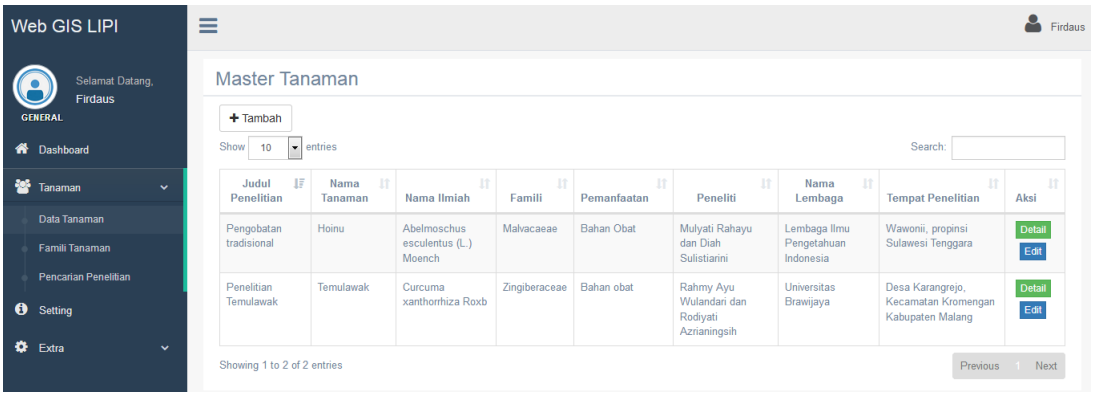

Fig. 4: Display of Plants Collection Menu

In this form, the user can search the research data of medicinal plants. Display form search research title can be seen in Figure 5 below:

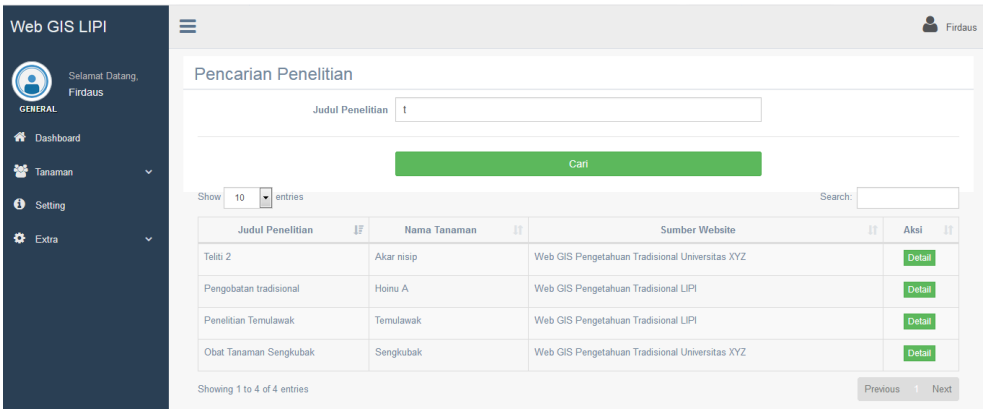

Fig. 5: Display of The Menu of Plant Research Search

5.2 White Box Testing

White box testing is done by testing the attributes and methods that exist in the modules built. White box testing is done based on the existing problem formulation is on the webservice which is the implementation of the SOA itself. This test starts from the WebGIS API coding.

```
public function insert(){
    $this->validation();
    $this->db->trans_start();
    $this->db->insert('master_tanaman',$this->input->post());
    if($this->db->trans_status()){
        $this->db->trans_commit();
        echo json_encode(['status'=>true,'msg'=>'Berhasil Menyimpan Data','code'=>200]);
        exit();
    } else {
        echo json_encode(['status'=>false,'msg'=>'Gagal Menyimpan Data','code'=>500]);
        exit();
    }
}
public function search(){
    $judul  = $this->input->post('judul_penelitian',true);
    $cari   = $this->db->select("*, master_tanaman.id as id_penelitian, famili as nama_famili, source_web.domain")
            ->join('source_web','source_web.id=master_tanaman.id_source')
            ->like('judul_penelitian',$judul)
            ->get('master_tanaman')
            ->result();
    echo json_encode(['status'=>true,'msg'=>'','code'=>200, 'data'=>$cari]);
}
public function detail(){
    $id = $this->input->post('id',true);
    $detail   = $this->db->select("*, master_tanaman.id as id_penelitian, famili as nama_famili")
            ->join('source_web','source_web.id=master_tanaman.id_source')
            ->where('master_tanaman.id',$id)
            ->get('master_tanaman')
            ->row();
    echo json_encode(['status'=>true,'msg'=>'','code'=>200, 'data'=>$detail]);
}
```

Fig. 6: Display of The Part of the WebGIS API coding

5.3 Black Box Testing

Black box testing is done to test the functions of the designed software. The truth of the software being tested is only viewed based on the output generated from the data or input conditions provided for the existing functionality regardless of how the process to obtain the output. The following functional testing system:

TABLE III: Black Box Testing

No.	Testing Activity	Expected realization	Results
1.	Click the login button	Go to dashboard	succeed
2.	Click the plant data button	Appears menu options add, edit, and details of the plant	succeed
3.	Click the plus button on the menu plant data	Added menu appears plant data	succeed
4.	Click the save button on the menu add plant data	New plant data stored	succeed
5.	Click the edit button on the menu plant data	Edit menu appears plant data	succeed
6.	Click the details button on the plant data details menu	Appears details menu of plant data	succeed
7.	Click the plant family button	Appears menu option added and edit plant family	succeed
8.	Click the add button on the plant family menu	Appears menu added family plant	succeed
9.	Click the edit button on the plant family menu	An editing menu of the plant family appears	succeed
10.	Click the save button on the plant family menu	Plant family data stored	succeed
11.	Click the research search button	Search research menu appears	succeed
12.	Click the details button on the research search menu	Appears detailed research data	succeed

6. Conclusion

Based on the presentation of research proposals above, the essential component in this tudy can be summarized as follows:

1. Thi study aims to build a model of web-based GIS to facilitate the control and monitoring of traditional knowledge is to perform digitization and mapped using a geographic information system.
2. Contributes in this research that tries to combine the approach of soft system methodology (SSM) and service-oriented architecture (SOA) for building web-based GIS and provide recommendations web-based GIS model of traditional knowledge in Indonesia
3. The study consists of six phase of the research include of literature study phase, the phase of data collection, analysis phase with SSM, the analysis phase based on SOA, UML modeling phase and web-GIS design phase.

7. References

[1] A. M. Abbasi, M. A. Khan, M. Ahmad, and M. Zafar, “Medicinal Plant Biodiversity of Lesser Himalayas-Pakistan,” Med. Plant Biodivers. Lesser Himalayas-Pakistan, vol. 9781461415, pp. 1–220, 2012. https://doi.org/10.1007/978-1-4614-1575-6_1

[2] E. Arévalo-marín, J. Ribamar, D. F. Lima, A. Ramlo, T. Palma, and R. Farias, “Traditional Knowledge in a Rural Community in the Semi- Arid Region of Brazil : Age and gender patterns and their implications for plant conservation,” vol. 344, no. December, pp. 331–344, 2015.

[3] D. Sensuse and Lukman, “Knowledge Management Model and Strategy of Genetic Resources and Traditional Knowledge in Indonesia,” Int. J. Comput. Sci. Issue, vol. 9, no. 2, pp. 480–488, 2012.

[4] E. K. Damayanti, E. A. . Zuhud, H. M. Sangat, and T. Permanasari, “Pemanfaatan Dokumentasi Pengetahuan Lokal Tumbuhan Obat Untuk Mewujudkan Masyarakat Mandiri Kesehatan (Utilizing Local Knowledge of Medicinal Plant Documentation toward Health-Independent Community),” in Seminar Nasional Etnobotani IV (National Conference on Ethnobotany IV), 2009, pp. 239–244.

[5] A. Ramadhan, D. I. Sensuse, and A. M. Arymurthy, “A proposed methodology to develop an e-Government system based on Soft Systems Methodology (SSM) and Focus Group Discussion (FGD),” in 2011 International Conference on Advanced Computer Science and Information Systems, 2011, pp. 147–152.

[6] H. I. Chunpir, T. Ludwig, and A. A. Badewi, “Using Soft Systems Methodology (SSM) in Understanding Current User-Support Scenario in the Climate Science Domain of Cyber-Infrastructures,” in Third International Conference, DUXU 2014, 2014, vol. 8519, pp. 495–506.
https://doi.org/10.1007/978-3-319-07635-5_48

[7] B. Williams, “Soft Systems Methodology,” 2005.

[8] A. Naseer, H. I. Aldoobi, and B. Y. Alkazemi, “A Service-oriented Architecture for GIS Applications.”

[9] B. A. D. Gbaffonou, J. Lapalme, and R. Champagne, “Service-Oriented Architecture : A Mapping Study,” in Third International Conference on Enterprise Systems, 2015.
https://doi.org/10.1109/ES.2015.11

[10] M. Zhou and W. Wu, “Development Of a Web-Based Geographic Information System for Crop Pests and Diseases Management,” in Information Management and Engineering (ICIME), 2010 The 2nd IEEE International Conference on, 2010, pp. 2–5.
https://doi.org/10.1109/ICIME.2010.5477696

[11] G. F. Nama, M. Ulvan, A. Ulvan, and A. M. Hanafi, “Design and Implementation Web Based Geographic Information System for Public Services in Bandar Lampung City - Indonesia,” in 2015 International Conference on Science in Information Technology (ICSITech), 2015, pp. 270–275.
https://doi.org/10.1109/ICSITech.2015.7407816

[12] M. I. Santoso, Z. Arham, and E. Khudzaeva, “Design of a web-based Geographic Information Systems Spatial for Distribution of Historic Site,” in Cyber and IT Service Management, International Conference on, 2016, pp. 1–5.
https://doi.org/10.1109/CITSM.2016.7577514

[13] F. Sulianta, Ai Rosita, and E. A. Laksana, “Integrated Model Development of Horticulture and Forecast Commodity using Web Based Geographic Information System and SMS Gateway Technology,” in Cyber and IT Service Management, International Conference on, 2016.

[14] S. Cha, Y. Hwang, Y. Chang, K. Kim, and K. Lee, “The Performance Evaluations and Enhancements of GIS Web Services,” in International Conference on Multimedia and Ubiquitous Engineering, 2007.
https://doi.org/10.1109/MUE.2007.205

[15] T. Melville, O. Baker, and D. Dolly, “Spatial Knowledge Interchange Environment: Leveraging Web 2.0 Technologies to Breach The Knowledge Divide in Agricultural Development,” 2012.

[16] Istikmal, T. A. Wibowo, and L. V. Yovita, “Puskesmas Information System Based on WebGIS,” in International Conference on Technology, Informatics, Management, Engineering & Environment, 2014.

[17] R. C. Ryser, Indigenous Peoples and Traditional Knowledge. Berkshire Publishing Company, 2011.

[18] M. Moshi, N. Nahar, R. Rahman, and K. Sakib, “MapBeing : An Architecture for Manipulating and Publishing Vector Data in Web based Geographic Information System,” in Software, Knowledge, Information Management and Applications (SKIMA), 2014 8th International Conference on, 2014.
https://doi.org/10.1109/SKIMA.2014.7083533

[19] P. Checkland and Scholes., Soft Systems Methodology in Action. England: John Wiley & Sons Ltd, 1990.

[20] Z. Zheng, D. Huang, J. Zhang, S. He, and Z. Liu, “A SOA-based Decision Support Geographic Information System for Storm Disaster Assessment,” in 18th International Conference on Geoinformatics, 2010. https://doi.org/10.1109/GEOINFORMATICS.2010.5567536

[21] Y. Feng and Q. Li, “The Distributed UDDI System Model Based on Service Oriented Architecture,” in 7th IEEE International Conference on Software Engineering and Service Science (ICSESS), 2016.

[22] A. G. De Prado, G. Ortiz, and J. Boubeta-puig, “CARED-SOA : A Context-Aware Event-Driven Service-Oriented Architecture,” IEEE Access, vol. 5, 2017.

[23] X. Lu, “Service and Cloud Computing Oriented Web GIS for Labor and Social Security Applications,” in The 2nd International Conference on Information Science and Engineering, 2010.