Web and GIS as a New Generation KM system for Sustainable Energy Promotion

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ABSTRACT

The sustainable energy services aim to reduce the use of the fossil energy and to meet the electricity needs of un-electrified area or remote area. Fossil energy has been used for ages. The amount of it is reducing that causes the high prices in the market. In order to overcome this problem, sustainable energy services should be promoted, particular in developing countries where a huge amount of sustainable energy resources are available. A viable tool which supports the activities on sustainable energy services is knowledge management (KM) system. However, there are some hidden practical problems on the current KM system on sustainable energy: lack of in dept knowledge, limited budget and high turn over of specialists. This paper will present a new KM system with integrated web GIS for delivery and promotion of sustainable energy.

Keywords : *Geographic Information System (GIS), Sustainable Energy Services, Knowledge Management (KM), Web Services.*

1. INTRODUCTION

Sustainable energy is an energy that obtains from sustainable energy resources such as solar, hydro power , biomass etc. The technologies of sustainable energy are not new. They have been discovered and implemented in many countries but they are not popular due to the initial cost of the system is quite expensive and the limitation of the knowledge for these technologies which has been distributed in only some communities. Under consideration, the long-term utilization of these technologies is more efficient in terms of cost, energy consumption and less environmental problems. The report shows that the technologies of sustainable energy are ready to use and the potential of the sustainable energy, throughout the world, is adequate to employ the sustainable energy technology [1]. However, the lack of knowledge is the main obstacle to promote or enhance these sustainable energy technologies. Hence, KM system would be an approach that offers the abilities to promote the utilization of sustainable energy technology. The main purpose of this paper is to suggest a new generation of KM system to promote sustainable energy technology. The following sections outline the various components of the KM system for sustainable energy technology including sustainable energy technology, knowledge management system, KM tools, discussion and conclusion.

2. SUSTAINABLE ENERGY TECHNOLOGY

The latest developments in sustainable energy technology and a good understanding of the opportunities and limitations involved in its application are very important in contribution of KM system for sustainable energy technology. The followings are some examples of sustainable energy technologies.

Solar Dryers are the thermal application of direct solar energy. They have been used in rural areas for long-term storage. The traditional drying method has many disadvantages such as loss of nutrition, germination, color, and quality. In addition, rain, insects and enzymatic reaction may cause problems. The new solar drying method has been developed in order to increase performance of the dryer and reduce the drying time [1,2]. The examples of solar driers are solar tunnel dryer, solar cabinet dryer, solar rack dryer, and solar pipe dryer. Fig 1 shows the solar cabinet dryer for banana, jackfruit and fish.

Fig. 1 Solar cabinet dryer [2].

Stand alone solar application is one of photovoltaic (PV) panel application systems which use solar radiation to generate electricity. The typical generating of stand-alone solar applications is shown in Fig 2. The PV array (solar cell) receives the solar radiation and converts it into Direct-Current (DC) or Alternate Current (AC) by using an inverter. After that the power is used by specific applications. In the case of the application will not be used, the power will be collected into batteries. Solar traffic lights, the examples of a stand alone solar application were installed in Naresuan University, Phitsanulok, Thailand [1].

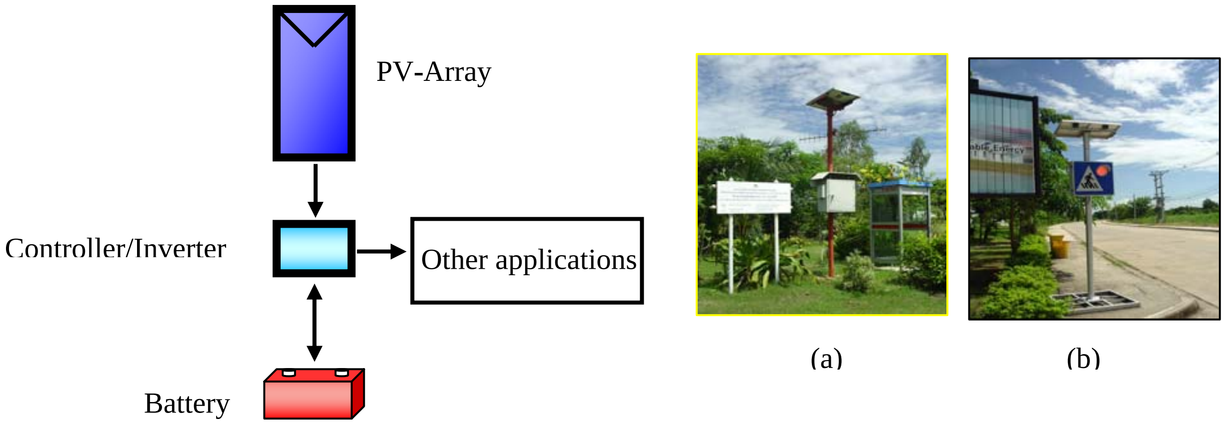

Fig. 2 The typical of stand-alone solar application generating and the examples: (a) solar phone and (b) solar traffic light [1]

Pico hydro power system is an application of hydro power that uses the free stream from water sources to power a small electrical generator (maximum 5 kilowatt). By the size of this hydro power system, it benefits over the larger systems in terms of cost and simplicity of design. The most important element is called the “drop”. A great amount of change in a stream’s elevation is important for producing the electricity. A pico hydro power system can generate the electricity from a small stream or a small river with a good drop. Only small water flows are required for this system [1]. For example, the use of pico hydro system in remote area of Kenya, The villages those are called Thima and Kathamba gain benefits from pico hydro power system such as household appliances, extending working hours and receiving the vital public health information via news and communication tools [3]. Fig 3 shows the examples of pico hydro power in Laos.

As can be seen from the examples that several sustainable energy technologies are available and offer high efficient to transfer.

Fig. 3 The examples of pico hydro power system in Laos [1].

3. KNOWLEDGE MANAGEMENT (KM) SYSTEM

Knowledge Management (KM) involves in the capturing, defining, storing, categorizing and linking of knowledge; searching for and subscribing relevant content from appropriate sources; and presenting the contents with sufficient flexibility [4]. Such knowledge is thereby made available in ways that can assist users on to discover the meaningful knowledge for an organization or a community. Traditionally, there are two categories of knowledge: explicit knowledge and tacit knowledge. Explicit knowledge is usually represented in document, book, report, video and database. Tacit knowledge is personal knowledge, which is derived experience, embodies beliefs and values. In addition, KM system supports tacit knowledge and meta-information creation. KM system also connects users with the stored knowledge; people with people, and with people who possesses specific tacit knowledge [5]. KM system is not a single technology, but instead, it is a collection of indexing, classifying and information-retrieval technology system that is coupled with methodologies designed to assist the users for the purpose of extracting meaningful knowledge [6]. According to Tiwana and Ramaesh [5], Table 1 shows the components of a knowledge management technology framework. These components provide integrative, complementary mechanisms for creating and managing knowledge in KM system.

Table 1 Components of Knowledge Management Technology Framework [5]

Components of Knowledge Management Technology Framework	
Components	***Organization Process Supported***
Document management tools	Publishing, distribution
Workflow tools	Organizational procedure and routines
Transparent capture tools	Noninstrusive capture
Web conferencing tools/Expertise pointers	Communication, dialogue
VoIP	Informal conversations
Electronic ”watercoolers”	Conversations
Visual thinking tools	Knowledge maps
Decision support systems	Problem solving, decision support
Digital whiteboards/Shared workspaces	Brainstroming, tacit knowledge capture
Data warehouses/Webhouses	Operational data, data mining, knowledge discovering, validation cleaning
Groupware, extranets	Collaboration, coordination
Intranets	Distribution, connectivity, publishing

For example, the transformation between tacit and tacit knowledge can be implemented by groupware which is a fairly board category of application software that helps individuals to work together in groups. Typical facilities of groupware are sharing of documents and discussions which allows integration of several applications for information sharing and conduct of asynchronous discussions [5,7]. Another example is the research of the Knowledge and Learning Environments for European & Creative Organizations (Klee&Co). This research focused on document archiving and searching engines. By collaboration tools, Knowledge transfer tools, Document management systems and Expertise location tools, the system could support knowledge sharing, promote learning processes and support working processes providing “the right knowledge at the right time”[8].

In order to distribute knowledge on sustainable energy technology to the public, many approaches have been explored. KM system would be appropriate to promote and enhance the utilization of sustainable energy technology. As an example, KM system can be expressed in the form of training lessons to be delivered in education or training institutes. At the end of such a program, the students are expected to understand the process of building energy from sustainable energy technology [9]. Another example, the use of Integrated Renewable Energy System (IRES) was developed for building energy services to support rural population in developing countries. IRES was a stand alone system that used a relational database and search algorithm. The objective was to find a combination of PV and/or Wind-Electric Conversion System (WECS) rating and the size of storage that minimizes capital cost and without compromising the loss of power supply probability [10]. The last example is mini grid system for un-electrified villages in the north of Thailand. The system consisted of a renewable energy hybrid power plant, a low voltage grid line, loads and energy management system. This system also generated 170 kWh/month that could be converted and used, with the total plant efficiency calculated to be 60.5%. The energy management system, a computer program, offered ability to determine the most effective energy sources to supply the required load [11].

It is obvious that all these examples offer inadequate services for the wider community. First, all of them are working on stand-alone system. The ability of these systems is inadequate for build up the energy services due to data on database was not update. Next, the utilization is limited such as the training course is used only in the university. Also IRES and the energy management system are used only the researcher community. Next section will introduce the use of web technologies in order to enhance the features and to sustain the relevancy and usefulness of the KM system on sustainable energy technology.

4. WEB TECHNOLOGIES AND GIS

The evolution of web technologies has brought new opportunities to develop the KM system. The potential of web services enable the sharing of functionalities across the boundaries of computing platforms, network architecture, operating systems and programming languages [12]. The typical web service model consists of a number of entities – service providers, services brokers and service requesters. Service providers create web services for the public and register the services with the service brokers. Service brokers maintain a registry of published services. Service requesters find their required services by searching the service brokers' registry. Requesters then bind their applications to the service provider to use the particular services [13]. Figure 4 illustrates the typical web service model.

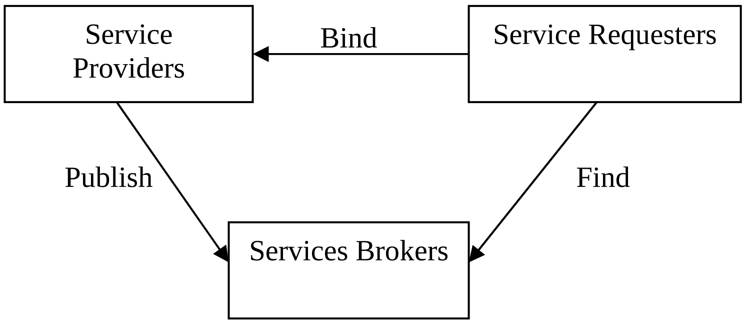

Fig. 4 The typical web service model [13].

Geographic Information System (GIS) is an information system which is used for the management, analysis, and display information in the form of geographic perspective, data view, visualization and model view [14]. GIS has been an effective tool for implementation and monitoring of municipal infrastructure due to the advantage: planning of project, make better decisions, visual analysis and improve organizational integration. The main potential of GIS is mapping process between spatial data and non-spatial data. Integrated web technologies with GIS that is called web GIS will be able to serve multiple users with information both spatial and non-spatial on variety of platforms including desktop workstation and servers over the Internet. Web GIS is a web application that has significant benefits for data mangers and developer alike, providing an environment for rapid system development and potential, overcoming longstanding issues of security, update and licensing [15]. GIS software is installed only on the servers. Clients can use the benefit of the software via web browser without installation. The example of Web GIS, the severe acute respiratory syndrome (SARS) GIS portal reveals in figure 5. The SARS GIS was established in order to monitor and analysis the spread of the disease over the geography of China. This portal analysed based on the SARS statistic of World Health Organization (WHO) and Hong Kong government [15]. Also it gives the reliable information of SARS such as the infection and the situation of SARS.

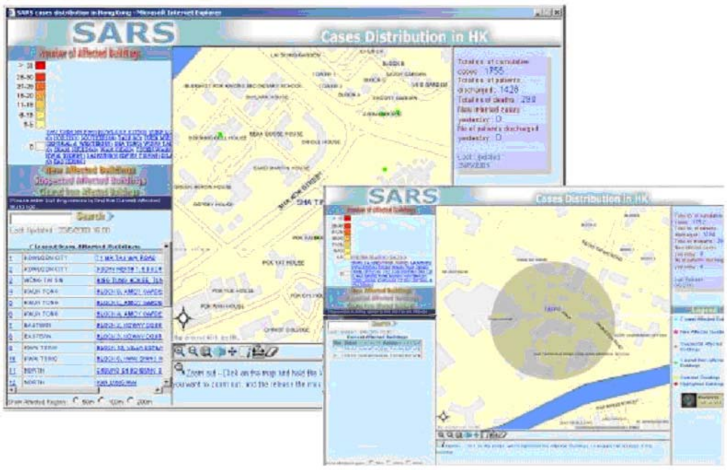

Fig. 5 Sample screen shots from SARS GIS [15].

From this context, web technologies and GIS are adequate potential and ready for employ KM system for scientific field or complicate principle such as sustainable energy technology.

5. KM SYSTEM FOR SUSTAINABLE ENERGY PROMOTION

According to sustainable energy technology, as seen some examples in section 2, the data or information on sustainable energy technology is in various form such as text, diagram, figure and the location of sustainable resources (spatial data). In order to enhance and promote sustainable energy technology, the most effective KM system has to support these various forms of sustainable energy data. With the potential of web service, any form of these data will reveal over the Internet. Figure 6 illustrates the knowledge server model.

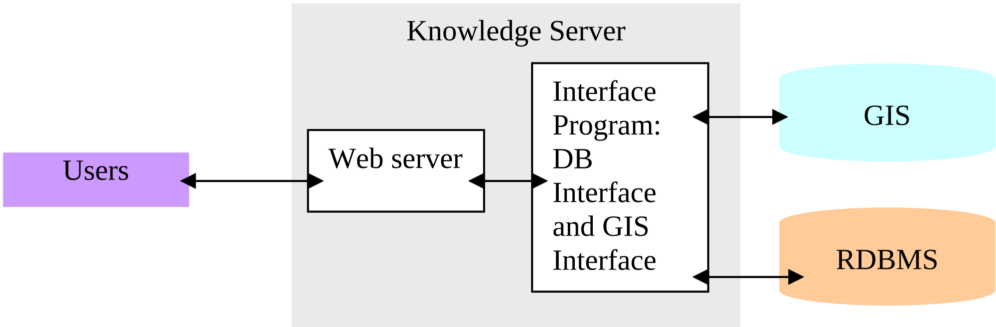

Fig. 6 Knowledge Server model.

A knowledge server model consists of web server and interface programs. The web server will receive request from users via browsers over the Internet. The server translates the request into the internal code and invokes the appropriate functions by passing the request to the interface program. The interface program will process the request and format the information from the GIS/RDBMS server for use by client browser application. . In addition, the integration of web GIS to the KM system allows user to access and analysis both non-spatial and spatial data. In the case of KM system on sustainable energy technology, some features are profiles, operations, lesson learned, indicators, forum and tools for design and planning. Furthermore, the potential of web GIS offers some of the features for non spatial data including the location of remaining energy resources, the amount of sustainable energy in specific location and analysis of the appropriate location to install the sustainable technology. This will lead to a better management on sustainable energy technology.

6. CONCLUSION

The paper presents a new approach for building up the KM system on sustainable energy technology. The integration of web technologies and GIS provide features that can promote the utilization of sustainable energy technology. For example, display the operations and help user to design and make decision on installing sustainable energy technology. However, the significant factors which affect the usefulness of the KM system such as the quantity and reliability of knowledge, bandwidth of network connection, the security across the Internet and user training in GIS should be concern for future study.

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