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Knowledge Management System for Efficient Use of Modern Rural Energy Services (MRES) in Thailand

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Abstract

In Thailand, the purpose of the Modern Rural Energy Service (MRES) projects is to improve the quality of life and elevation of economic advantages in rural areas (Ketjoy et al, 2004 and CASE, 2001). However, there exist many practical problems that hinder the success of the projects. Examples of the reasons are - high turnover of experts and specialists; lack of in depth knowledge on the system among the local users; high cost of the system, tools and equipment; and limited budget for planning, research and development. In order to overcome the above issues, Knowledge Management System (KMS) has been identified as a viable solution. Regarding the advance development on information and communication technology (ICT), the integration of knowledge management and Web technologies has been established as an invaluable tool. The combination has the potential to assist the promotion of knowledge management and related activities thereby enabling the acquisition of diverse types of information and data (Tiwana & Ramesh, 2001). The proposed research is to develop a KM platform based on Web technologies that will be a channel used by the stakeholders for the gathering, sharing, extraction and dissemination of knowledge about the MRES. Examples of the system functions will be - checking the type of renewable energy resources around local area; teaching of MRES development and maintenance processes; comparison for suitable MRES according to the users' location; forums, and FAQ's; sharing of best practices and discussion with experts…etc. The expected users and contributors to this system are the relevant government departments including the Provincial Electricity Authority (PEA), Solar Energy Research and Training Centre (SERT) and local administrators. This paper will present the overview of proposed research, important features, the prototype, functionalities and significant contributions. A case study based on this prototype will be implemented and studied at SERT at the later part of the study.

Keywords: Modern Rural Energy Service (MRES), Knowledge Management System (KMS)

1. Introduction

The main purpose of Modern Rural Energy Services (MRES) is the provision of energy to rural communities based on technologies that utilize renewable and traditional energy resources with high efficiency. Renewable energy is obtained from sources that include conventional hydroelectric power, wood fuel, biomass, waste residues, geothermal, wind, photovoltaic, and solar thermal energy that are essentially inexhaustible. Renewable energy service is a way to handle the expected shortage of energy that may occur in the not too distant future. For examples, the Mexican project manages to sustain the village power supply by using a combination of solar energy, geothermal energy, bio-energy and wind energy (Gutierrez-Vera, 2000). On the other hand, Vietnam, Thailand and Philippines use only solar energy to build electrical supply for local people who are facing shortage of energy (Basheer, 1996; Renewable Energy Technologies in Asia, 1998; PEA, 2004).

In the case of Thailand, it is an agriculture-based country and there are a lot of renewable energy sources, in particular, biomass and waste residues. These types of renewable energy sources have long been ignored due to the lack of knowledge and technologies in utilizing such resources by the local residents. Traditional energy resources such as wood or oil are also being used inefficiently. Recently, the government has launched the MRES project in order to improve quality of life in rural communities. For example, the International Centre for Application of Solar Energy (CASE) had been employed by Provincial Electricity Authority (PEA), Thailand to study the feasibility on renewable energy for island electrification in Thailand (CASE, 2001). The result showed that these islands were strongly suitable for the deployment of Modern Rural Energy Services (MRES). Another example is a study of the Mini–Grid

Concept for those villages which have no access to Electricity Supply in Thailand by the Solar Energy Research and Training Centre (SERT) at Phitsanulok. This project has employed a Hybrid system which is a form of MRES. The system was deployed in two non-electrified villages: Ban Pank Praratchatan and Ban Pank Sumnakngan. The result has shown that 60% of the villagers are satisfied with the system and have used the power supply for many electrical appliances (Ketjoy et al, 2004). However, there exist many practical problems that hinder the success of the MRES projects. Some of these reasons are listed as follows:

- High turnover of experts and specialist – Due to the fact that experts are in high demand by in many part of the world, upon completion of the project, these experts will move to other areas.
- Lack of in depth knowledge on the system among the local users – Due to MRES is employed in rural areas, most of the local users do not know the process or how the system works. If any error occurs, the local people do not have sufficient knowledge to maintain or repair the system. The system would be ignored or not used any more.
- High cost of the system, tools and equipments – MRES by itself can be expensive to purchase and implement. Some processes can also be difficult to follow or operate at the local level. Hence, it has been shown in some areas that MRES has been ignored even though there are sufficient potential to implement such system.
- Limit budget for planning, research and development – Due to limitation on the budget, it has experienced in the past that the project did not have sufficient fund to be completed in full. This has led to deficiency on the deployment and lack of efficiency of the final system.

It is obvious that due to lack of knowledge causes the use of MRES inefficiently at some rural areas in Thailand. One possible solution is the use of Knowledge Management System (KMS). KMS is an approach that can provide a platform to extract and exchange meaningful knowledge for the stakeholders relating to the design and use of MRES. An effective KMS platform has the potential to become an invaluable tool to assist the rural communities in Thailand in handling the challenges relating to their energy needs. This is the main aim of this research and the following sections describe various components of the proposed system in order to promote and enhance the efficient use of MRES in Thailand.

2. Knowledge Management System (KMS)

In order to distribute knowledge on MRES to the stakeholders and the public, many approaches have been explored. The concept of knowledge management (KM) has been known for many years. 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 (Zack, 1999). Such knowledge is thereby made available in ways that can help or assist the user on to discover the meaningful knowledge for an organization or a community. KM has been recognized as an important factor to increase the overall organizational value in terms of performance and assets. 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 from experience, embodies beliefs and values.

In addition, Knowledge Management System (KMS) supports tacit knowledge and meta-information creation. KMS also connects users with the stored knowledge; people with people, and with people who possesses specific tactic knowledge (Tiwana & Ramesh, 2001). KMS is not a single KM 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 (Lawton, 2001). 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 allow integration of several applications for information sharing and conduct of asynchronous discussions (Tiwana & Ramesh, 2001; IBM, 2004).

In the case of MRES, the ability of KMS including 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 will serve the right knowledge at the right time for the users' purposes (Albolino & Mesenzani, 2002). Hence, a KM platform would be appropriate to promote and to enhance the utilization of MRES by all stakeholders.

3. Web Technologies

KMS requires a variety of technical tools for supporting three areas: database management, communication/ messaging and browsing/ retrieval. The need for seamless integration of the various tools in these three areas may lead to the reliance on web technologies. The generation and evolution of web technologies have brought new opportunities to the development of KMS. Web Services are emerging as a leading technology to enable the sharing of functionalities across the boundaries of computing platforms, network architecture, operating systems and programming languages. These technologies are also supported by the international standards: Web Services Description Language (WSDL), Universal Description, Discovery and Integration (UDDI), and, the Simple Object Access Protocol (SOAP) (Castro-Leon, 2004).

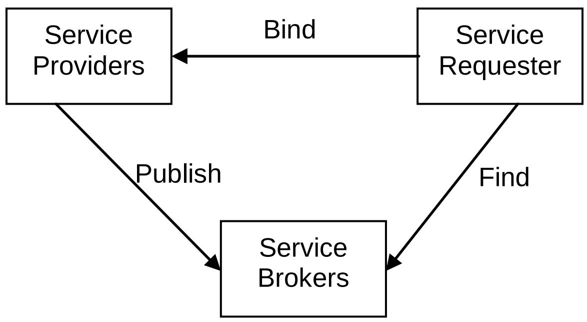

Figure 1: Web Services Consumer Model (Roy & Ramanujan, 2001).

Web services were originally designed as a method of inter-machine communication, which has been typically implemented in a client/server (C/S) model. In the C/S model, requests by a consumer client are made via a broker or project to web services from a remote server. It is this model which is mostly used for web services development. Figure 1 illustrates a typically web services consumer model that consists of a number of entities – service providers, service 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 (Roy & Ramanujan, 2001).

One significant component that should be recognized for implementation of KM platform is a tool that should provide the ability to transfer and share knowledge in a format easily understood by the users. It is because that the users can be local users, non-technical staff, technician or academics. Geographic Information System (GIS) is such a tool that can create KM platform covering technical and non-technical presentation. GIS has been used for the management, analysis, and display of information in the form of geographical perspective. Such information can be represented as a series of information maps, geographic data set, process, work flow models, data models and metadata (ESRI, 2005). The application of GIS can reveal the combination of information between several layers of conditions or variables at the same time as shown in Figure 2.

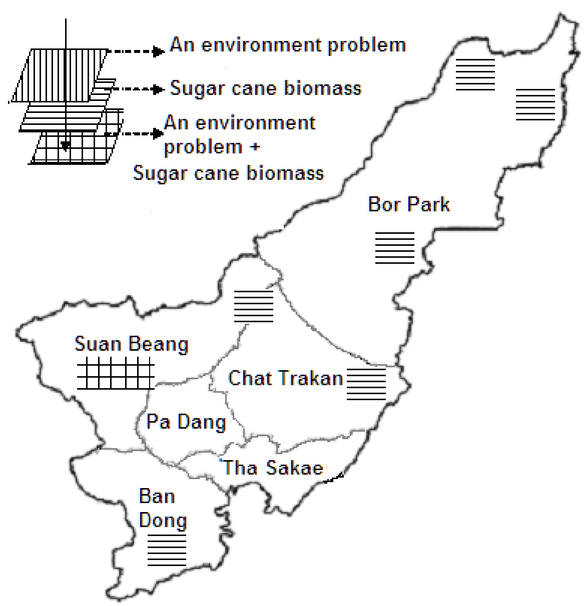

Figure 2: A sample of GIS view from the proposed KMS platform

For example, there is plenty of biomass such as sugar cane residues in the district of Chat Trakan at Phitsanulok, Thailand. This district consists of 6 sub-districts: Saun Beang, Pa Dang, Ban Dong, Tha Sakae, Chat Trakan and Bor Pak. Some sub-districts have reported problems on environmental issues due to accumulation of the residual wastes. With such knowledge, local people could initiate project or plan to dispose the unwanted biomass from sugar cane by the MRES. This will help to solve the problem of the unwanted wastes.

The potential use of GIS over the Internet is supported by three international Web services standards: UDDI, WSDL and SOAP. By linking GIS to Relational Database Management System (RDBMS), this can offer the operational functionalities relating to both spatial and non-spatial data (Babo, 2005). GIS is also capable to serve multiple users with information in multimedia formats on a variety of platforms via the World Wide Web (Soomro et al, 1999). With the integration of web services, GIS and other related tools, it is expected that the features and core knowledge on MRES stored in the KMS could be visibly promoted and exchanged (IBM, 2000; Tiwana & Ramesh, 2001).

4. The Proposed KM Platform

The proposed KMS is a system that enhances an individual's tacit and explicit knowledge on MRES for all organizations and stakeholders by using web services and GIS platform. Figure 3 illustrates the components of the proposed system. A *browser* is defined within the context of this study as a stakeholder or anyone who retrieves information from the system for the purposes of taking some lessons, or, to use collaborative services such as online discussion. A *subscriber* receives similar services as a browser. However, enhanced information and services are provided to a subscriber. These additional services include the use of tools for planning and design. A *knowledge server* consists of a web server and interface program is a middleware between the users and the both GIS DB server and DB server. It facilitates integration, organization and aggregation of spatially distributed explicit content and tacit knowledge pointers.

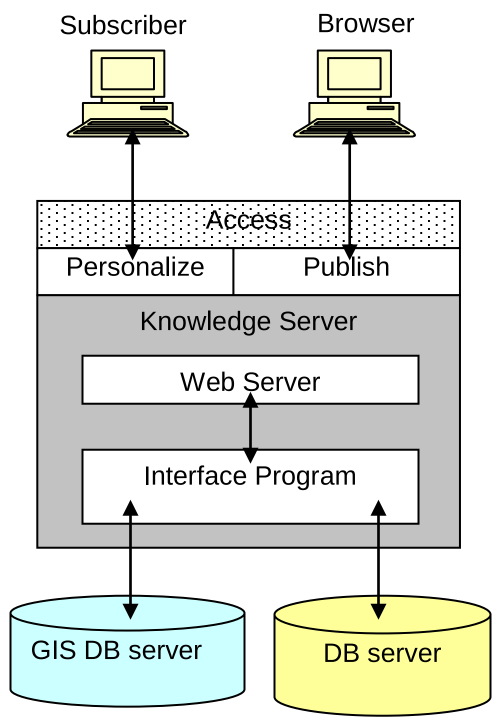

Figure 3: Proposed KMS for MRES

The Web server will receive request from subscriber/browser via the Internet. The server translates the request into 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/Database servers for use by the client browser application. All stakeholders will provide the knowledge in the forms of entries in GIS server and database server, publications and collaborative exchange.

The proposed platform provides applications for the purposes of data compilation, information query, spatial analysis, geo data processing, production of cartographic products, and visualization of multimedia images. Figure 4 shows an example screen of displayed page on the proposed system. The sample screen consists of two parts: map and text link. The map of Phitsanulok is displayed as a province in Thailand where the implementation of the KMS will be based. From the displayed page, appropriate links will provide access to information about renewable energy sources, the process of build up MRES in specific areas on the map and so on. Each link will connect to another page that will show particular features. Selection the link in the form of text or map will access a particular feature.

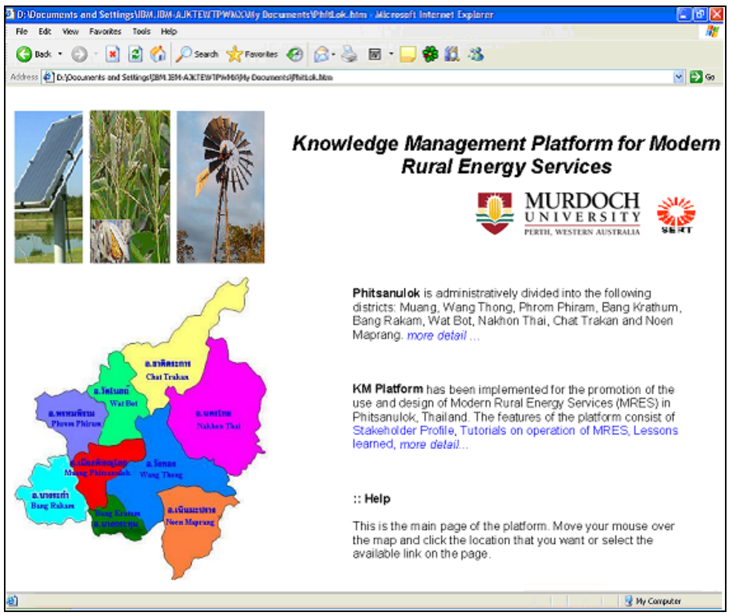

Figure 4: A sample screen of the proposed platform

For example, the link on lessons learned will show a number of case studies and provide research or information on MRES in the selected area. The other possible features of the proposed system are profiles of manufacturers and stakeholders, tutorials on operations of MRES, lessons learned, comparison indicators on renewable resources and economic factors, archives, calendar, discussion forum, and, tools for design and planing.

5. Functionalities and significant contribution

The proposed platform will help local users/browsers to gain more knowledge on MRES in their local area. Provided by different features to be accessed from the platform, the users will be able to learn lessons on how to use the power with high efficiency, and the relevant information of their renewable energy sources such as biomass (Sugar cane, Paddy, etc.). The main contributor to the knowledge base of the proposed KM platform will be the subscribers. In other words, the relevant government departments including the Provincial Electricity Authority (PEA), Solar Energy Research and Training Centre (SERT) and local administrators. SERT is a research centre at Naresuan University (NU) in Phitsanulok, Thailand. NU is a local university and SERT has been conducting applied researches in the discipline of renewable and solar energy for over six years. One of the aims of SERT is to utilize solar energy technologies to meet energy needs in developing countries and around the region (SERT, 2005).

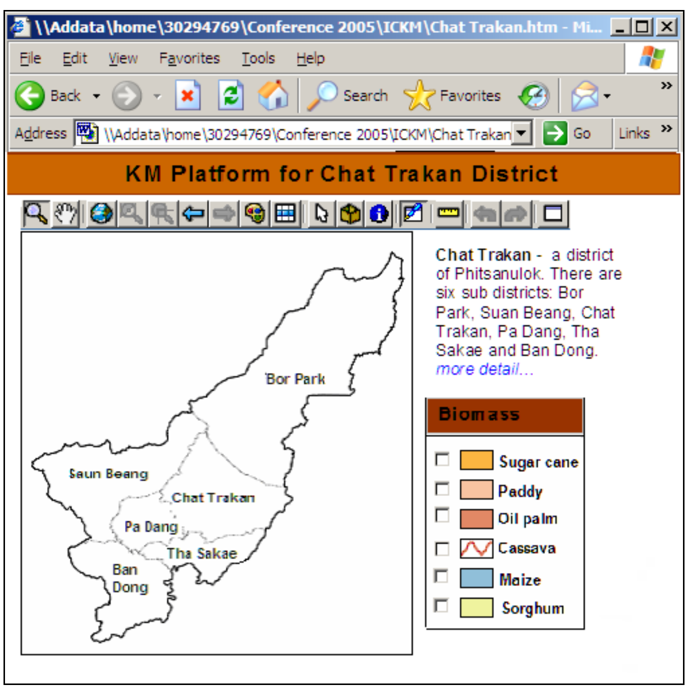

Figure 5: A sample screen of GIS application

The subscribers, who are related to the development or responsible for improving quality of life of local communities, can gain and share additional knowledge on MRES. By using the proposed KMS platform, the subscriber can be empowered with knowledge and know-all to assist them to develop appropriate MRES for their respective location. By using the most appropriate process to generate electrical power from local renewable energy resources, this will meet the need of the local community while reducing the environmental impacts. Another function of the proposed system is to show the number of renewable energy resources in specific areas. An example of the application screen is shown in Figure 5. Application based on GIS allows a subscriber to select the types of biomass on the specific area (Chat Trakan). By selecting check box of Paddy and Oil palm, the location of both renewable resources will be shown on the map as the same view as Figure 2.

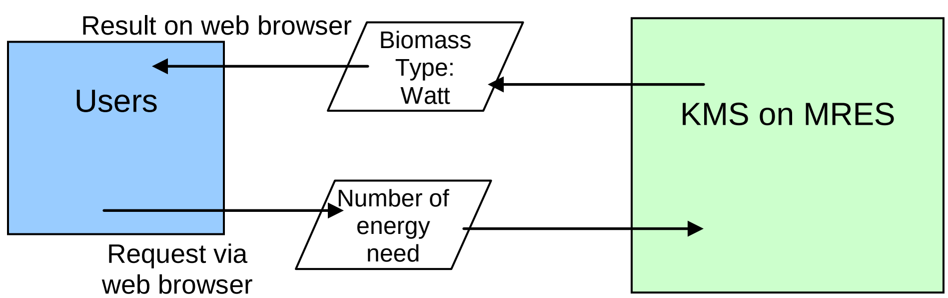

Figure 6: An example of a transaction on query from the KMS

In addition, the proposed platform would assist the user in selecting the most suitable type of renewable energy resources for the MRES. Figure 6 illustrates the use of one of the functions on the proposed platform. Subscriber can input the number of power demand via web browser. Then the result will show how much power that each renewable energy resources can create.

6. Conclusion

This paper reports the initial phase of a project on the development of a KMS platform for the efficient use and design of MRES in Thailand. It is recognised that renewable energy will be the answer to the problem of meeting electricity demands at rural areas. In addition, proper design and use of MRES will also assist in disposing unwanted residual agricultural wastes. While MRES technologies have advanced and much experience or lessons have been learnt from the past years, such knowledge have not been made available or easily accessible by many stakeholders. The proposed KMS will be based on state-of-the-art web technologies, web services and integration with GIS and RDBMS. The proposed system will include functionalities to facilitate the *browsers* who are the consumers of the knowledge from the MRES. The contributors to the knowledge of the system are *subscribers*. Apart from enjoying the same facilities provided to the browsers, they also play a crucial part in contributing knowledge to the system. The project is in the initial stage and the background has been discussed in this paper. A number of prototype screens are also included in this paper. The scope and requirements of the system will be under constant refinement and updates. Subsequent development will be reported in the near future.

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