IMPROVING THAILAND LIFE ENVIRONMENT WITH KNOWLEDGE ON SUSTAINABLE ENERGY

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ABSTRACT

This paper reports on a knowledge management (KM) platform that aims to promote knowledge and the utilization of sustainable energy among Thai communities. The system is based on a web GIS (Geographic Information System) server-side application. Information on sustainable energy resources in the Phitsanulok province, Thailand is made available to the users. The three categories of users are general users, researchers and local government officers (LGA) The information on the local energy resources also helps the LGAs to select the most appropriate location for designing and developing sustainable energy services. In order to assess the effectiveness of the system, the participants asked to answer questionnaires before and after they had accessed the platform. The results of the survey revealed that the KM platform helps the local people to improve their knowledge and utilization of sustainable energy thereby improving their life environment.

KEYWORDS:

Knowledge Management System (KMS), Sustainable energy service, Web GIS (Geographic Information System)

1. INTRODUCTION

Sustainable energy services aim to improve the quality of life and elevate the economic conditions for the communities. Such services are gaining attention and interest due to the declining availability of traditional energy resources and the increasing energy demands (WEC 2001; Hammons, Boyer, et al 2000). In addition, increasing awareness of issues such as global warming, carbon emissions, peak oil and the need for sustainability development have kindled strong interests in sustainable energy around the world (EREC 2006; WWF 2007). However, the utilization of sustainable energy services has been limited due to the lack of knowledge on sustainable energy technologies (Billinton & Karki 2001; Schlapfer 2002). In the case of Thailand, there are a number of existing projects, which involve the deployment of sustainable energy among the local communities. These projects are mostly funded by the government and mainly concentrate on the use of modern and efficient technologies. The projects also normally involve transfer of knowledge on the successful projects, to the communities. However, there are practical problems (Ketjoy, Sirisumpunwong, Thanarak, Rakwichian, & Chew 2004) that may hinder the success of the projects. This includes high turnover of experts and specialists, lack of in depth knowledge about the system among the local users, high costs of the system, tools and equipment and limited budget for planning, research and development.

The main obstacle that prevents Thai communities from using the local sustainable energy resources efficiently is the limited distribution of knowledge about sustainable energy technologies. This leads to the challenge, on how to enhance Thai people's knowledge in order to enable them to gain benefits from sustainable energy services. Knowledge Management System (KMS) is an approach that can provide a

platform to extract and exchange meaningful knowledge for the design and use of sustainable energy services (Wei, Hu & Chen 2002). Using a web-based application, the KMS could be enhanced to enable the distribution of knowledge all over the world, within a short period of time (Murray 2002; Handzic & Sarajevo 2005). It is obvious that the Internet infrastructure is a significant factor for easy access to web-based KMS. In the case of Thailand, the infrastructures for Internet connections via both land lines and satellite are readily available within the country (Cusripituck 2005; Bhongsatiern 2004; Rattakul 2002). It is anticipated that the proposed KM platform could become an invaluable tool to assist Thai communities in handling the challenges relating to their energy needs, by using sustainable energy services (Payakpate, et al. 2006). In this paper, it is reported that the developed web-based KMS has shown to be an effective tool to improve and to facilitate knowledge distribution about sustainable energy among the local communities. The following sections outline a background review of sustainable energy services, technologies and tools related to the web-based KMS and an evaluation of the system.

2. SUSTAINABLE ENERGY SERVICES FOR THAILAND

Sustainable energy services refer to the provision of energy from sustainable resources, to meet the energy needs of the community. In particular, appropriate technologies relevant to the sustainable energy are utilized. The service could include traditional energy sources and renewable energy resources. Traditional energy sources are wood, oil, coal and natural gas. On the other hand, renewable energy resources are diverse natural resources, which are essentially inexhaustible and include conventional hydroelectric power, geothermal, wind, solar, etc. In the case of Thailand, the resources available in the farming and agricultural communities are biomass and residual waste. While nuclear power has been considered as a form of renewable energy, it is not included as a viable energy source to be used in Thailand. It is recognized that nuclear power is relatively efficient and it does not generate air pollution, greenhouse effects or acid rain (Hore-Lacy 2000; Virtual Nuclear Tourist 2005). However, high investment is needed to build the nuclear power plant (Priwan 2007; WWF 2003). In addition, there are concerns regarding the safety issues and it also requires resolution to address the long term high radioactive level waste storage issue (WWF 2003). The lengthy process of establishing nuclear plants is another important factor, as the need for energy in Thailand is imminent. Finally, it requires a large amount of manpower which is specialized in nuclear power technologies (Sumitra & Chankow 1997) before nuclear power could be deployed. Therefore, nuclear power has not been considered as a part of sustainable energy in this study.

Sustainable energy services are essential for the development of local communities and particularly in Thailand where a high potential for sustainable energy resources is available (EPPO 2007). The reports by the Energy Information Administration (EIA) of Thailand and Energy Policy & Planning Office (EPPO) of Thailand show that the energy production is less than the energy consumption in every type of energy resource (EIA 2006; EPPO 2007). The trend of energy consumption is growing, due to the increasing population and the improving standard of living (PEA 2004; WEC 2001). In addition, the availability of traditional energy resources has not increased and in fact, it is reducing yearly due to inefficient usage (EPPO 2007). Therefore, steps must be taken to prevent a severe shortage of energy in the future. A possible solution is to increase the rate of development and installation of efficient sustainable energy services among the communities. Thailand is an agriculture based country and there are plenty of renewable energy resources in the form of biomass and waste residues. However, traditional energy resources such as wood or oil are not being used efficiently. Increasing utilization of sustainable energy services could address the energy issues. It could also improve the quality of life in Thailand with a reduction in CO_2 emissions. For example, the building of a dam will not only offer hydro-electricity, it also creates new job opportunities for local people around the dam with activities such as fisheries, eco-tourism and an irrigation system for farms and orchids around the region. Energy from biomass can reduce the amount of waste residue in local areas and help the disposal of excess agricultural products from the market, thereby maintaining a reasonable price for the producers. Even though sustainable energy services provide many advantages, the utilization of these services is still low due to a lack of knowledge. Therefore, an effective platform for the distribution of knowledge and experience gained from the existing sustainable energy systems will bring forth additional benefits. Knowledge Management System (KMS) is an approach that can be used to distribute knowledge on sustainable energy services to the communities. The next section provides a description of the web-based KMS and the relevant tools used.

3. WEB-BASED KNOWLEDGE MANAGEMENT SYSTEM (KMS): TECHNOLOGIES AND TOOLS

KMS refers to applications which are based on the integration between Knowledge Management (KM) mechanisms and information technologies (Becerra-Fernadez, Gonzalez & Sabherwal 2004). KM is the name given to the set of systematic and disciplined actions that an organization or individual can take in order to obtain the greatest value from the available knowledge (Marwick 2001). Traditionally, there are two categories of knowledge: explicit knowledge and tacit knowledge. Explicit knowledge is usually represented in documents, books, reports, videos and databases. Tacit knowledge is personal knowledge derived from experience, embodies beliefs and values. KM involves 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).

Table 1. KM technologies, applications and advantages (Ardichvili 2002)

Technologies	Applications	Advantages
Intranets and extranets	Based on widely available Internet infrastructure, these technologies can be used to build a basic, relatively inexpensive KMS	Provides a unified and familiar Web-based interface; allow access to various sources of information internal and external to the organization and to information on the Internet; perfect for the distribution of knowledge throughout the company; allowing collaboration between users
Virtual community, collaboration tools	Allows geographically dispersed members of teams and informal communities to interact over the Internet	Enables the generation and exchange of tacit knowledge in formal and informal communication within virtual communities of practice
Data warehousing, mining, and analysis tools	Electronic warehouse of Internal corporate data; equipped with pattern recognition and data classification tools for analysing large amounts of stored and incoming data, and uncovering connections and relationships that are not apparent	Useful in organizing and making sense of large amounts of corporate data; could be used to generate, store, and disseminate new explicit knowledge
Web-based business intelligence systems	Uses intelligent agent-based search mechanisms to uncover and extract data from competitor and customer locations on the Internet	Allows for the infinite extension of the internal company knowledge base by incorporating relevant information from the Internet
Automatic tools for generating new knowledge	Could include neural networks, genetic algorithms, and fuzzy logic systems aimed at automatically generating new knowledge without the immediate participation of human beings	Designed to extend or replace the work of live domain experts

In order to develop an effective KMS, the appropriate technologies need to be considered. These technologies should support the different formats of knowledge and KM functions: acquisition and capture, storage, retrieval and distribution and presentation. In the case of the sustainable energy sector, information and knowledge on sustainable energy technologies are represented in various forms such as text, diagrams and figures. The location or spatial data of sustainable resources are beginning to emerge as an important aspect of the knowledge. KM plays an important role for improving these areas in terms of monitoring the investment, and sustaining the use of natural resources (Ketjoy, Schmid & Rojanaporn 2003; Rumakumar 1996; Zahedi 1998). Web technologies include applications to support and facilitate the provision of information on sustainable energy services to the user such as Web GIS (Geographic Information System) and the internet based application. Web GIS is a web-based application that enables knowledge sharing and distribution of sustainable energy technologies over the Internet including spatial information (Li 2003;

Soomro, Zheng & Pan 1999). It offers significant benefits for data managers and developers alike and provides an environment for rapid system development. In addition, because the information is served from dedicated servers, it has the potential to address issues such as security, updating and licensing (Babo 2005; Tang & Selwood 2003; Raghavan, Santitamont & Honda 2005; ESRI 2005). Thus, Web GIS is able to form the basis of effective KMS for promoting the utilization of sustainable energy services (IBM 2000; Tiwana & Ramesh 2001).

4. AN EXISTING WEB-BASED KMS ON SUSTAINABLE ENERGY TECHNOLOGIES FOR THAILAND

A KM platform has been implemented using a web GIS server-side application and it was installed at the School of Renewable Energy Technology, Naresuan University, Phitsanulok, Thailand. Prior to the implementation of the KMS on sustainable energy technologies, data and information on sustainable energy technologies had been collected. They are classified into two categories: knowledge on sustainable energy technologies and regional data of sustainable resources around the region of Phitsanulok, Thailand. The first category of knowledge was created and captured from the stakeholders and experts among the energy sectors and the electrical power industry. The second category, local data about the Phitsanulok region, was collected from related public organizations such as the District Agriculture Extension Office from each district (also known as "Ampher" in Thai). The information is in the form of text, figures, tables and spatial data. Both categories of data are then converted to the appropriate formats and stored on the server. Figure 1 shows an example of a screen display of the system. Each link will connect to another page that shows particular features. For example, the link on operation shows a number of sustainable technologies that are used to generate services for the community.

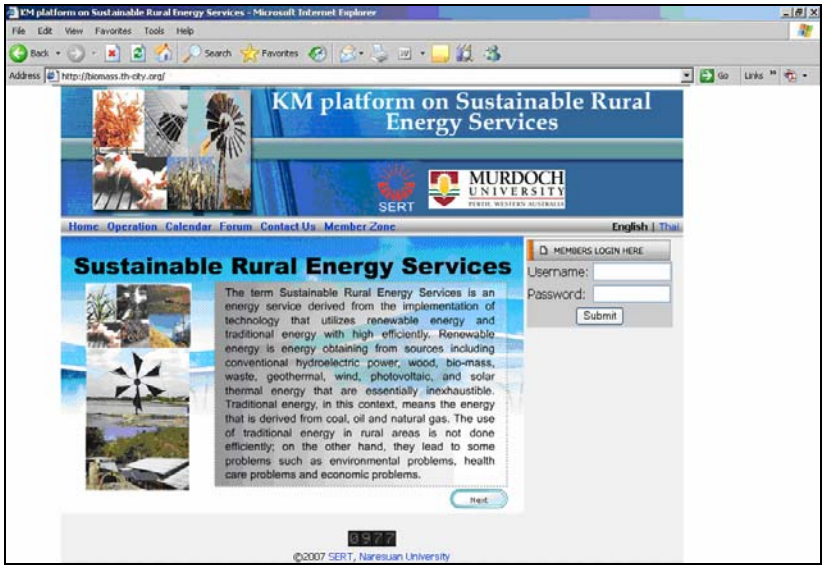

Figure 1. Main page of the KM platform on sustainable energy technologies

The KM platform helps local users to access knowledge on sustainable energy technologies, in their local area. Figure 2 describes the groups of participants and their permissions to access the features on the platform. There are three groups of users: general users, researchers and local government administrators. The general users may browse and learn information on sustainable energy and how to operate the sustainable energy system with better efficiency. Researchers are divided into two categories: normal users and administrators. Normal users are researchers who have access priority similar to the browsers. In the case of researchers with administrator status, the researchers have additional privileges in accessing additional knowledge that is related to their research work or to provide advice in the forum. In the context of Thailand, each province is divided into sub-districts which are known as "Tambons". The Tambon council members are the local government administrators (LGAs) who will provide and access local

information from the system (Department of Local Administration of Thailand 2007; Cusripituck 2005). LGAs are responsible for the development and are responsible for improving the quality of life among the local communities (Department of Local Administration, Phitsanulok 2007).

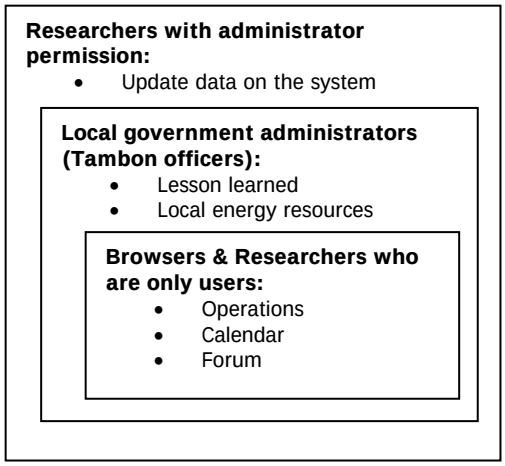

Figure 2. Permission to access to features of participants

The KM platform has been launched to the public since February, 2007. Surveys in the form of questionnaires were used to evaluate the effectiveness of the platform. The purposes of the pre-questionnaires are to gather information on the participants' background, participants' knowledge on sustainable energy and the internet infrastructure of the community. In this study, there were 142 participants took part in the study: 15 questionnaires were completed by LGAs, 32 questionnaires by researchers and 95 questionnaires by general users. The results show that all the participants know how to access the internet. The popular places that they use to access to the internet, are 64.79% accessing from home, 81.69% accessing from their offices, 14.08 % accessing at the library and 14.79% accessing at the internet cafe. The majority of the internet activities of LGAs and general users are browsing or researching. E-mail is the most popular form of communication among the researchers. The survey also involves a set of "Pre-test" questions, which comprise of fifteen multiple choice questions in order to evaluate the participants' knowledge on sustainable energy. The mean values of the pre-test are shown in Figure 3. Similar tests were conducted after the participants had used or accessed the KM platform for a minimum period of time. This is called the "post-questionnaires". From the results of these questionnaires, it was indicated that the web application is an appropriate tool to communicate and facilitate the transfer of knowledge. The results also demonstrate that most of the participants are familiar with the World Wide Web (WWW) and they prefer to use the features on the web such as e-mail and news. In addition, access to the WWW is also sufficiently supported by both private and public internet service providers.

Table 2. Mean value of the satisfaction of the KM platform

Criteria	LGAs	Researchers	General users
1. The graphical user interface of KM platform is user friendly.	3.20	3.29	3.49
2. The information on the KM platform is up to date.	3.27	2.94	3.47
3. The KM platform provides communication between you and others or experts i.e. e-mail, forum and etc.	3.27	2.82	3.40
4. The KM platform provides meaningful information.	3.40	3.18	3.85
5. The KM platform provides adequate information on Sustainable Energy Services for designing and building sustainable energy services.	3.13	3.29	3.58

The purpose of the post-questionnaires is to evaluate the usefulness of the KM platform and to estimate the improvement of participants' knowledge on sustainable energy technologies and services. There were 110 participants who returned the post-questionnaires: 15 questionnaires completed by LGAs, 18 questionnaires by researchers and 77 questionnaires by general users. A Likert scale of 1 to 5 was used to

measure the satisfaction of participants with respect to the platform by setting up the criteria showing in Table 2. It shows that the participants are in general satisfied with the platform. In particular, item number four (The KM platform provides meaningful information) gained the average highest score. Therefore, the format of the platform and knowledge on the platform has been well received and accepted by the participants.

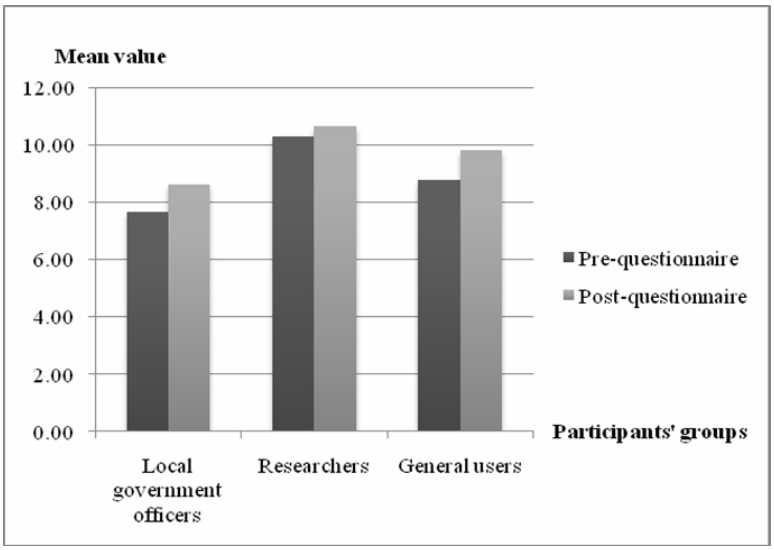

Figure 3. A comparison of the mean values between pre-test and post-test

The post-test was set up to measure the knowledge on sustainable energy of the participants after they had accessed the platform. The comparison of the pre-test and post-test between each group is shown in Figure 3. The mean values of post-test increased in all three groups. It indicated that the knowledge on the platform may have improved the understanding of the participants on sustainable energy. It is expected that a better utilisation and efficient use of the sustainable energy resources will lead to improvement of the life environment for the local communities. This will be the next phase of this study to assess the impacts and benefits of the KM platform in leading to the implementation and utilisation of the sustainable energy services.

5. CONCLUSION

This paper reports the development and the use of a web-based knowledge management system (KMS) as an effective tool to improve knowledge on sustainable energy technologies for communities in Thailand. The background of the research and design of the web-based KMS is reported on. Web GIS plays an important role in the delivery of knowledge on sustainable energy over the KM platform. The evaluation of this research has adopted a pre- and post- questionnaire approach. Pre-questionnaires reveal the participants' familiarity with the world-wide-web. The pre-test was also set up to assess the participants' knowledge on sustainable energy before they tried the KM platform. The post-questionnaires aim to evaluate the usefulness of the platform and to measure the improvement of the understanding on sustainable energy of the participants. The results show that participants are familiar with the web, the KM platform provides a meaningful and useful source of knowledge, and the system also improves the participants' knowledge on sustainable energy in the communities. The KM platform provides the ground work for further implementation and utilization of sustainable energy services for the improvement of the life environment in Thailand.

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