

Chapter III

METHODOLOGY

The Thai herbal medicine search engine, based on an ontology of Thai herbal medicine and a semantic search system, has been developed to assist information search by the of Thai herbal and Traditional Medicine Information Service (TTM-IS).. This ontology, is designed to be a knowledge information system representing the domain knowledge of Thai herbal medicine and identifying relationships among their terms and concepts.

System Framework

The system framework as shown in Fig. 6 consists of modules of a knowledge base, an ontology, a database and a user interface. Ontology technology was used in creating conceptual knowledge for Thai herbal medicine. The herb database, which was initially created with MS Access, was exported to MySQL database servers. The database data was then integrated into the ontology to create the knowledge base in the RDF (Resource Description Framework) format by using Ontology Application Management (OAM) framework. In addition, the OAM semantic search application template is adopted in order to create the search system and user interface. After implementing all these steps, the user can perform the querying process on top of the provided SPARQL query facility. This chapter focuses on the scope of domain knowledge necessary for answering relevant queries regarding TTM.



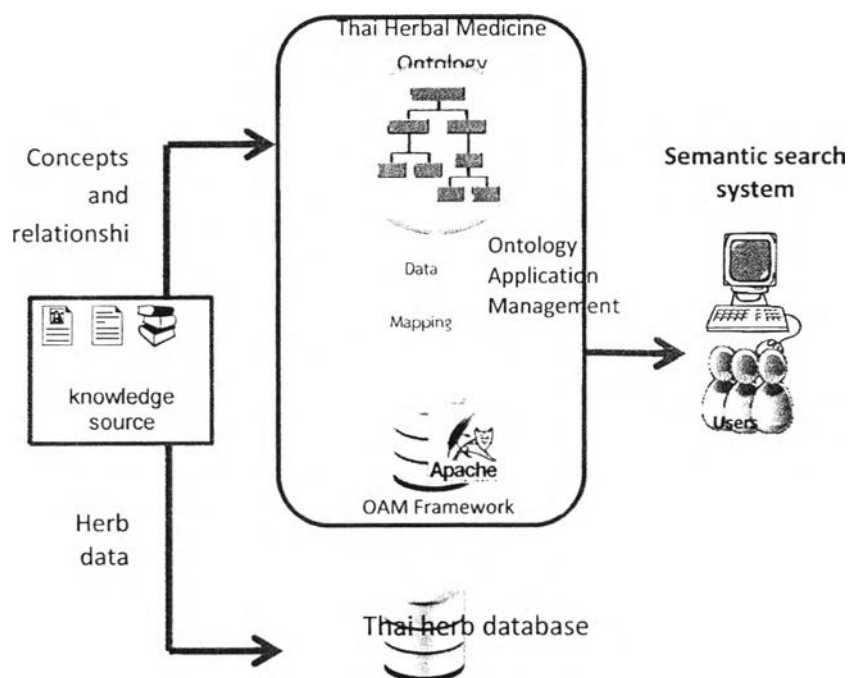


Figure 6 System framework

Materials and Methods

Materials

- 1) Hozo Ontology Editor, developed by the Institute of Scientific and Industrial Research, Osaka University, (Kozaki et al., 2007)
- 2) Ontology Application Management (OAM), developed by the Language and Semantic Technology Laboratory, National Electronics and Computer Technology Center (NECTEC) (Buranarach, Thein, & Supnithi, 2013)
- 3) MySQL 5.0
- 4) Microsoft Access 2010



Methods

The methods of this study involve three main steps,

- 1) Verification of information need
- 2) Ontology development
- 3) Ontology evaluation

1. Verification of information need

This step involved a surveying and an identifying the scope and types of information needed by TTM-IS in answering questions received from users. This was achieved by reviewing questionnaires filled by the staff of TTM-IS and in-depth interviews with the Thai traditional doctors at Chao Phya Abhaibhubejhr Hospital.

2. Ontology development

The methodology framework of ontology development. Is shown in Fig. 7



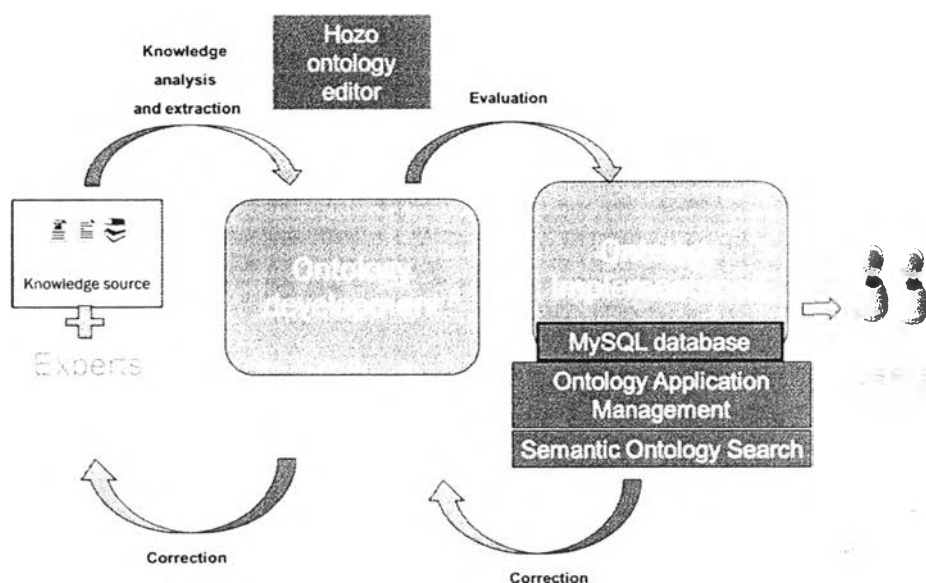


Figure 7 Ontology development framework

The ontology development consists of three steps: 1) knowledge analysis and extraction 2) ontology development and 3) ontology implementation. The first step involved analyzing and extracting knowledge from experts, documents and materials at Chao Phya Abhaibhubejhr Hospital. Triangulation was applied in the data collection, analysis and extraction process to ensure the creditability and conformability of the study. Concepts resulting from this step was then used in the ontology development process. The second focuses on developing the ontology schema by using Hozo Ontology Editor as an editing tool. The schema was subsequently evaluated by experts to ensure the conformability and validity before the implementation step. The third step involved database development by using Microsoft Access, MySQL database, and the ontology schema; and data base mapping by employing Ontology Application Management (OAM) and semantic

ontology search system. The resulting semantic search system enables users to browse information on herbal medicine.

The following sections describe ontology development and evaluation in detail.

2.1. Ontology development include the following steps:

2.1.1. Extraction of relevant information on herbal medicine

The scope of knowledge of Thai herbal medicine and information collection was defined, and The concepts regarding medicinal plants were formulated according to those found in *TamraPramuanLakPhesatchakam* (Watprachetuphol, 1978) and *WetchasuksaPhaetThayasatSangkhep: Manual for Student of Traditional Medicine by Phraya Phitsanuprasatwet* (PhrayaPhitsanuprasatwet, 1908). The concepts of illness/health problem and disease in TTM were extracted from *PhaetsartSongkroh: Medical Wisdom and National Literary Heritage* (Thai Language Institute, 1999) which has served as a key textbook on TTM containing a collection of *kamphi* or medical treatises officially endorsed by the Ministry of Public Health and widely used as reference sources on Thai traditional medicine. It contains theories of Thai traditional medicine and pharmacy regarding diagnosis, treatment methods, causes of illness, herbal medicine preparations, etc.

The numbers of herbal medicines according to the types of health problems included in this study are shown in Table 2. The scope of data collection was based on the types of health problems about which

questions are most frequently asked. The herbs and formulations in the database are from the drug lists of Chao Phya Abhaibhubejhr Hospital.

Table 2 Scope of data collection

Health problem	Herbs/ herbal remedies from the hospital drug list
Gastrointestinal system	5 herbs/ 6 remedies
Musculoskeletal system	2 herbs/ 4 remedies
Respiratory tract system	1 herbs/ 5 remedies
Diabetes	2 herbs/ 1 remedies
Fever	3 herbs/ 5 remedies
Total	13 herbs/ 21 remedies

2.1.2. Identification of concepts/classes

The concepts or classes of domain knowledge were enumerated for inclusion in the ontology. The knowledge domain in this study covers information of Herbal medicine-Herbs, Taste, Tri-That, Formulation, Indication, Preparation, Use Method and Clinical Warning. All these concepts are contained in the knowledge base and linked to the relevant information in answering queries by users.

2.1.3 Definition of the hierarchy of classes

This step involved assigning the superclasses or subclasses relationships of classes, which are represented in a hierarchical form. The



knowledge hierarchy model was created by using an ontology editing tool, Hozo Ontology Editor .

2.1.4 Definition of data properties and object properties

In this step, the properties of the classes were assigned. There are two types of properties to be defined: data properties and object properties. The data type properties are used to describe the value type of the classes such as string, boolean, number, etc. The object properties are used to describe the association of two related concepts/classes in ontology. It provides more information of the attached superclass. All the properties provide more information about the attached class.

2.1.5 Preparing the database on Thai herbal medicine

The ontology schema was then exported from Hozo Ontology Editor to the Ontology Web Language (OWL) (Smith, Welty, & McGuinness, 2009), a representation language which is used as a representation language of THMO. Meanwhile, the Thai herbal medicine database created with MS Access was exported to MySQL database server in order to prepare data for data mapping in the next step.

2.1.6 Mapping THMO with the Thai herbal medicine database and creating the knowledge base

The data mapping process in this step used the Ontology Application Management (OAM) software tool . With support of OAM, mapping between the OWL ontology and the database schema can be performed using a graphical user interface. After the database-ontology mapping process, the tool allows creation of



the knowledge base in RDF format (RDF Working Group, 2007). In order to generate applications of THMO, the OAM semantic search application template was used in developing a concept-based search system for Thai herbal medicine, which allows user to browse and search for the relevant information.

3. Ontology evaluation

The evaluation of the ontology was conducted after the final schema of ontology had been completed. To test the validity of classes, subclasses, vocabularies and relationship identification in the ontology, experts from two professional groups, ontology engineers and Thai traditional doctors, were asked to fill out questionnaires to assess and make suggestions on the ontology schema. A focus group discussion was held specifically among the traditional doctors to achieve a consensus of opinion. At this meeting the contents of the ontology schema from the concepts, their relationships, the hierarchy of classes and subclasses were explained to them before they started the discussion and filled out the questionnaires afterward. The ontology schema which was improved according to the experts' comments and suggests was to be used for the implementation step.

An 'expert' here is defined as those who has at least 3 years of work experience in his/her respective field and remains an active practitioner in that field. In all, eight experts, two ontology engineers and six Thai traditional doctors, were enlisted to assess the Thai traditional medicine ontology. Evaluation criteria consists of correctness of classes; subclasses; properties identification; reliable and reusability of the ontology.



Evaluation criteria

- **Correctness** refers to the degree to which the classes, subclasses and properties are properly defined with respect to the domain knowledge.
- **Consistency** refers to the degree to which there is no overlapping of the subclasses and sets of properties the ontology contains no classes which contain the same set of subclasses and no classes contain the same set of properties
- **Conciseness** refers to the degree to which the classes, properties and relationships in the ontology are relevant to the domain knowledge and included in the ontology map. No identical names must be assigned to different classes, and irrelevant classes, properties and relationships must be excluded.
- **Future development and reusability** refers to the degree to which the ontology is reliable and reusable, and whether it can be applied to other domain knowledge.



Theme list questions are as follow:

1) Correctness

- Does the ontology capture the concepts of Thai herbal medicine correctly?
- Does the ontology capture the properties of Thai herbal medicine correctly?
- Does the ontology capture the relationships between classes/subclasses of Thai herbal medicine correctly?
- Does the ontology capture the data types? of Thai herbal medicine correctly?

2) Consistency

- Does the ontology include two or more concepts that share the same subclasses?
- Are there any circularity errors found in the ontology?
- Are there any inconsistencies of terms used in the ontology?

3) Conciseness

- Does the concepts in the ontology fall outside the frame of the domain knowledge?
- Does the properties in the ontology fall outside the frame of the domain knowledge?



- Does the ontology capture the relationships between concepts outside the frame of domain knowledge correctly?
- 4) Future development and reusability
- Is the ontology reusable?
 - Can the ontology be applied with further application or to other domain knowledge?

Data Analysis

Descriptive data analysis, mean and standard deviation were applied in calculating the experts' evaluation scores. The degree of the experts' opinion are classified as follows.

Remark	Score
Strongly agree	5
agree	4
Neutral	3
disagree	2
Strongly disagree	1



Trustworthiness of the study

This study has adopted a set of procedures to enhance the trustworthiness of its findings in the following aspects:

- To ensure creditability, triangulation was used in the extraction and conceptualization of data from various sources.
- To ensure conformability, triangulation was employed to validate data gathered from the focus group discussion and those from the questionnaires filled out by the experts during the ontology development process
- To ensure the transferability or reusability of the study, the ontology was evaluated by experts by using questionnaires.

