

# Information System for Mobile Medical Service Operation Management

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**Abstract—** This research develops work flow and information system (IS) design for mobile medical service in Thailand. This system focuses on developing supporting system for service site selection which is the first and essential step for responding demand of remote area people. This study is divided into 3 steps: study medical service existing operation and criteria, developed site selection support model, and design an IS to increase efficiency of data communication among relevant administrative units. The preliminary outcomes of this research have been presented to responsible persons from mobile medical service providers and relevant administrative units through brainstorming seminar. The seminar attendees have agreed with the proposed system and have been confident that it can support the current operating objectives.

**Keywords—** information system, mobile medical service

## I. INTRODUCTION

The mobile medical service is given by a healthcare service team including physicians, dentists, pharmacists, nurses, and health officers who go directly to operation sites for providing medical treatment, health rehabilitation to remote residences where are far away from healthcare stations or hospitals.

This paper uses the ideology of the Princess's Mother Medical Volunteer foundation (PMMV). The PMMV is established by Princess Mother Srinagarindra in 1969. The objective of this foundation is to provide medical treatment and primary health sanitation to people living in remote areas where are far from healthcare stations or hospitals. Current provided services comprise of mobile medical unit, mobile dental unit, and medical service for eye diseases including screening, operating, and medical provisions for special cases diseases. There are 53 provinces as main customers of the foundation.

## II. STATEMENT OF PROBLEMS

Currently, the management of the PMMV foundation operations includes cooperation and coordination between mobile medical service providers and relevant administrative units which are health stations, health districts offices, province public health offices, and the foundation central office in Bangkok. There are 3 major processes in the PMMV foundation operations: service site selection, on-site operation,

and resources preparation. The service site selection is the first step and crucial process. The site selection planning is starting from health stations send illness lists to health districts office. Secondly, each health district office primary chooses service sites appropriately. Then each health district sends the service site requisitions to province public health office. Service site decisions will be revised again and will be proposed the promising site for service operations by the foundation central office. In addition, site selection decision helps providers i.e. province public health office to prepare resources (type of medical staffs and kind of medical supplies) according to types of treatment required. Finally, the foundation central office launches the plans that compose of operations scheduling, and medical stuffs and relevant provider list.

Data communications are the main key of management. From surveys and interviews, it shows that each unit still use paper-based communication and information systems for data structure records and data transfers are different (see fig. 1). These can cause data communication problems such as incorrect or ambiguous information, slow data transfer, data transfer failure, etc. Moreover, the retrospective data almost without IS supporting systems (i.e. electronic health records, history of service plan, etc.) lack in information warehouse which is vital for management and decision making process [1], [2]. This study aims to develop work flow and information system designs of service site selection in mobile medical service to fulfil working efficiency.

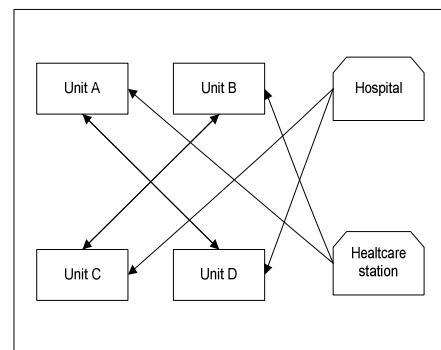


Fig. 1 Data Transfer line during relevant administrative units [3]

### III. METHODOLOGY OF THE STUDY

The study of this paper was conducted in 3 steps: existing operation study, to-be process design, and IS design (see Fig. 2)

In order to understand the existing operations, many in-depth interviews with some mobile medical service providers and relevant administrative unit staffs were conducted. In addition, many on-site visits were made on many occasions at various locations. The literature surveys are also performed to find out the ways to improve site selection work process and design IS for mobile medical service to framework of study. It is important to note that the framework scope is the general situation exception emergency cases.

To-be process is developed by integrating relationships during mobile medical service providers and relevant administrative units as to-be conceptual structure, business flow charts, and an IS devices for fulfill working.

The standard IS is to appropriately designed for each relevant administrative unit users in order to each units can be connected and transferred efficiency data.

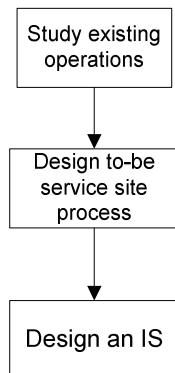


Fig. 2 The overall concept of the study

### IV. RESULTS

The study of existing operations gives more understanding of current operations. Especially, the coordination and cooperation between mobile medical service providers and relevant administrative units such as health stations, health districts offices, province public health offices, and the foundation's central office in Bangkok, and current provided services are revealed in this step.

Then conceptual structure under real-world of this framework and business flow charts are the results of to be service site process.

Information system and information technology support operation management for developing work flow process. UML, and graphic user interface are devices that authors design.

#### A. Conceptual Structure

From as-is surveys, there are 5 relevant administrative units from downstream unit to upstream unit which can be order as follows: health stations, health districts offices, province public health offices, hospitals, and the foundation central

office. These units work their function and obligation differently. The conceptual structure (see Fig.3) show integrated relationships of management and control during upstream unit to downstream unit, and illustrate unit linkage interactions that show communication from downstream unit to upstream unit.

Information technology supports the overall of operations management such as internet, intranet, and extranet applications. Internet can help for implementing supply chain solutions to add value to medical service providers, administrative users [2]. Moreover, the internet systems have various ones to enterprise-wide system via network which connect and share information within unit or inter-unit become a standard network system. These are created an additional benefit for mobile medical information providers and able to utilize data record and information to betterment of the PMMV community [2]. An intranet is a collection of inter-connected networks within a unit, usually based on Internet technologies [2]. The growth in medical intranets can be attributed to its advantages; (1) low-cost connectivity, (2) ease of rapid deployment of the technology, (3) use of cross industry communications standards, (4) user-friendliness, (5) short training times, (6) reduced network administration costs, (7) the ability to extent the value of legacy systems, and (8) the ease of development of strategic links between healthcare organizations and outpatient providers including physicians [2]. In addition, intranets make the connection to health care information systems, including DSSs developing computerized data record systems. Extranets offer a way to link services in a more timely, efficient manner, and secured connectivity [2]. Illustrative figure for sub-conceptual structure inside each unit (see Fig. 4) shows that each unit have functions to interact with user, such as to store data, to acquired data, to evaluate service quality, and to support decision making in continuous quality improvement [4].

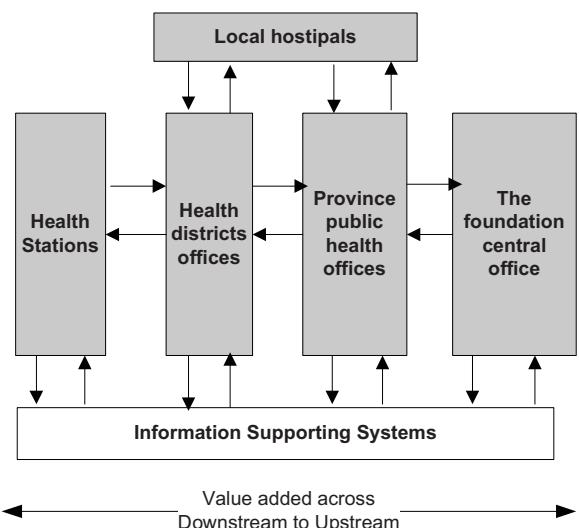


Fig. 3 Conceptual structure of mobile medical service operations management

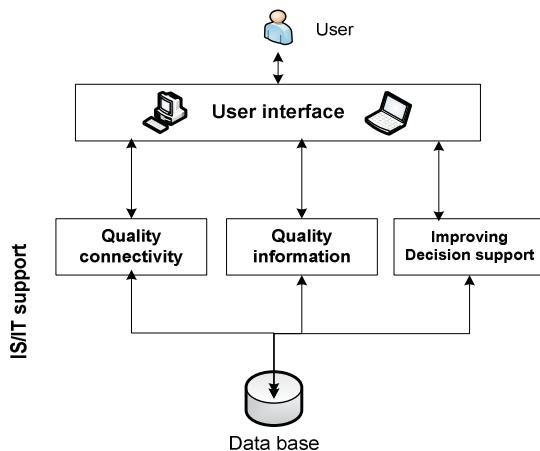


Fig. 4 The architecture of sub-conceptual structure inside each unit

The site selection process is shown in Fig. 5. The process begins with an input or customer needs which can be defined as number of patients and services needed (types of illness) at the service location in this case. After customer needs are retrieved, the services is planned, managed, and controlled by supporting data, information, or decision. The output of this process is to plan all resources (physicians, medical supplies, staffs, etc.) according to customer needs. Finally the output of this process is the serviced given to customers.

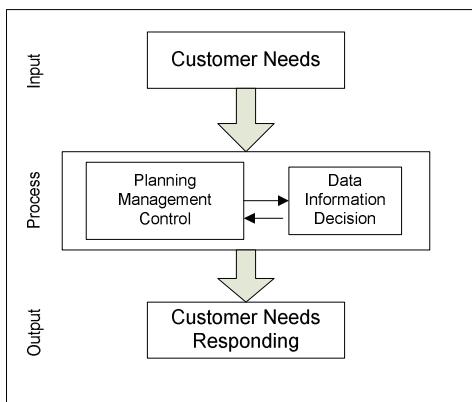


Fig. 5 Site selection process

#### B. Business Flow chart

Business flow chart is the detail in conceptual structure. It is developed for 5 administrative units from downstream unit to upstream unit. The business flow charts show whole work flow of site selection planning and responsible units in each step of process (see Fig. 6).

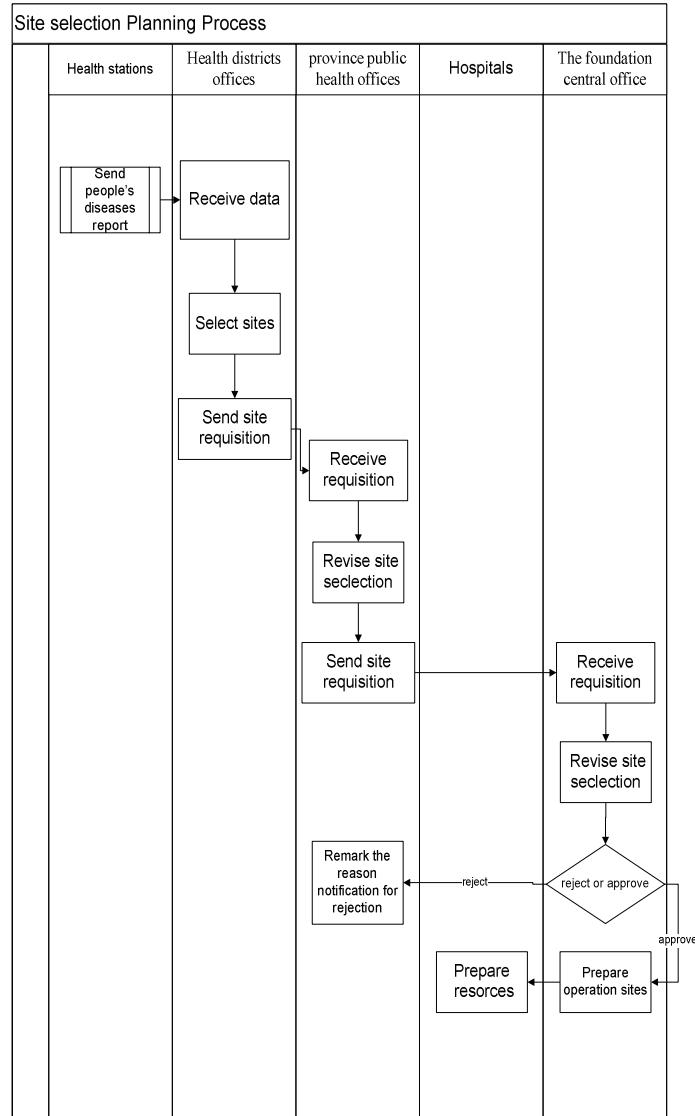


Fig. 6 Site selection requisition planning flow chart

#### C. Unified Modeling Language (UML)

The UML is a standard modeling language with a rich graphical notation, and comprehensive set of diagrams and elements. Moreover, the UML is the one of application that is the most widely known by programmers [6], [7]. The UML allows more efficient communication between designers and programmers via various UML's tools. Many researchers used UML to develop the healthcare industry supporting system. Kyriacou E. et. al [8] designed and developed an integrated database system for support of an emergency healthcare using UML recorded and described all cases for aiding doctors and other paramedical personnel during their daily routine. Chatsatthar A. [9], Phongpithakchai S. [10], and Chintakovit P. [11] use UML as main development tools in hospital information system for support patient register, dispatching and billing system in small and medium size hospital to support basic operation of patient registration,

dispatching and billing, patient recording systems, medical supplies management system in small and medium size hospital, respectively.

There are many tools of UML such as Use-case diagram, Sequence diagram, Class diagram, Component diagram, State chart diagram, Interaction diagram, etc. In this study, the following tools have been used.

### 1) Class diagram

Class diagrams are the mainstay of object-oriented analysis and design. Class diagrams show the classes of the system, their interrelationships (including inheritance, aggregation, and association), and the operations and attributes of the classes [12],[13],[14]. Figure 7 shows a section of overall system of class diagram.

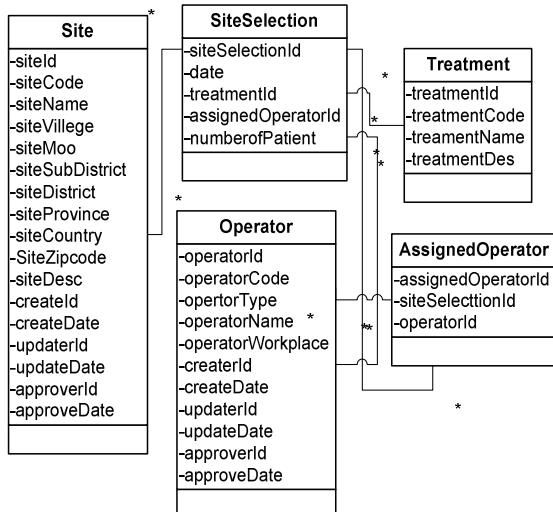


Fig 7 Class diagram

### 2) State chart diagram

State chart diagram shows event status. In Fig. 8, it shows the state chart diagram of operation site requisition step within site selection process. The status of this event can be one of the followings: waiting for approve, approved, closed, cancel, and rejected.

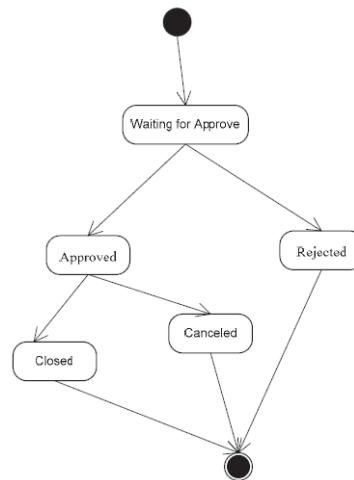


Fig 8 State chart diagram [5]

### D. Graphic User Interface (GUI)

GUI is to refer to the methods and devices that are used to accommodate interaction between machines and the human beings who use them (users) [15]. In designing GUI is one of interface design to facilitate users to appropriately communicate with the devices or program. In this study, GUI was designed each relevant administrative unit to support many users in order to work more effectively with a command-driven interface. Fig. 9 is an example to illustrates GUI of site selection requisition process each relevant administrative unit.

Figure 9 displays a Graphic User Interface (GUI) for operation site requisition. The interface includes a search form with fields for 'ชื่อบริษัท' (Company Name), 'จังหวัด' (Province), and 'วันที่ข้อมูล' (Date). Below the form is a table titled 'ตารางรายการ' (Table) with columns: สถานที่ (Location), กิจกรรมการรักษา (Treatment Activity), จำนวนผู้ป่วยที่คาดได้ (Estimated Number of Patients), จำนวนแพทย์ที่ออกใบสั่ง (Number of Doctors), and หมายเหตุ (Notes). The table has 10 rows and includes navigation buttons for 'ก่อนหน้า' (Previous), 'ถัดไป' (Next), 'สัมภาระ' (Attachments), and 'กู้คืน' (Restore).

Fig.9 Graphic user interface of operation site requisition

## V. CONCLUSIONS

The PMMV foundation operations are surveyed and studied. The PMMV mobile medical service operations are explored by on-site visits and the in-dept interviews with mobile medical providers and relevant administrative units. As-is surveys show that the operations management lack of standard supporting system. This study aims to develop work flow and

design an IS to support mobile medical service operations management. The improvement of as-is model can add to working efficiency. The conceptual structure is defined operation and relation in process of each relevant unit. The usage devices are Business Flow Chart, UML, and GUI. Moreover, these tools can reflect to real-world systems, and the UML language can be read and easily understood for designed model [14]. The benefits of information system supporting for this framework is shown in Table 1.

**TABLE I**  
**Benefits of Information Supporting Systems**

| <b>Benefits</b> |  |  |
|-----------------|--|--|
|                 | <b>Data</b>  | <b>Staffs</b>  |
| Processing Time | <ul style="list-style-type: none"> <li>-Decrease in processing time</li> <li>-Reach Information easily</li> <li>- Deliver on time</li> </ul> | <ul style="list-style-type: none"> <li>-Decrease in processing time</li> <li>-Eliminate unnecessary process</li> </ul> |
| Cost            | <ul style="list-style-type: none"> <li>-Save cost in paper-based data</li> </ul>   | <ul style="list-style-type: none"> <li>- Decrease paper-based</li> <li>-Low cost connectivity</li> </ul>               |
| Quality         | <ul style="list-style-type: none"> <li>-Accuracy, clear, reliability</li> <li>-Have the decision making process</li> </ul>                   | <ul style="list-style-type: none"> <li>-Able to high communication, connection, share, transfer</li> </ul>             |

The preliminary outcomes of this research have been presented to responsible persons from mobile medical service providers and relevant administrative units through brainstorming seminar. The seminar attendees include The PMMV foundation providers and administrators, Relief and community health bureau, Thai red cross society providers, Rachaburi province public health office providers, Rachaburi hospital providers, and a medical cadet form Fort Somdet Phra Nareshuan Maharat Hospital. The seminar attendees have agreed with the proposed system and have been confident that it can support the current operating objectives. In addition, the Secretary of The PMMV foundation and Former Deputy Permanent Secretary, Ministry of Health said in brainstorming seminar that this model can also support mobile medical service other organizations. All attendees hope that if the research is fully completed and applied to the mobile medical service industries, it will help increase the performance indeed.

The proposed system lays the foundation for better future operation performance. Along with information warehousing, it permits relevant administrative unit to save cost, provide better care, and save lives [2]. In addition, to better care of patients, it can be used with enterprise applications such as DSSs, and internet applications to give efficiency data communications among relevant administrative units. Finally, who involved in mobile medical service, whether as a patients, physicians, mobile medical service providers and relevant administrative units will receive the maximum benefits from these systems.

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