

# Project Management in Health GIS

**Boondao, R.**

Faculty of Management Science, Ubon Ratchathani University, Warinchamrap, Ubon Ratchathani 34190  
Thailand, E-mail: rboondao@hotmail.com

## Abstract

*Geographic Information Systems (GIS) have played an important role in healthcare areas. The development of systems such as epidemic disease controls, health GIS databases, healthcare planning systems, and other GIS applications for healthcare require a project manager who has a thorough understanding of project management knowledge. The way a health GIS project should be handled is different from a normal information system project. The health GIS project is a complex information system that needs to be careful handling. It involves development of software, appropriate hardware, a database, and the acceptance of the users. To develop a health GIS project effectively requires a lot of planning and a clear understanding of system objectives and user requirements. This paper presents a combination of information system development methodologies with best practices in health GIS systems to provide a framework to manage a successful health GIS.*

## 1. Introduction

There is a concern when a health GIS project is started about where the project might lead, whether information will have to be reversed later or that it will prove too costly to be implemented and be abandoned. An effective project management system can help to avoid these problems and create a successful health GIS project. A successful project must be on time, within budget, of good quality, and should meet user satisfaction (Huxhold, 1995). A health GIS project is a complex information system to develop and involves the gathering of user requirements, system design and development, system testing, and user evaluation. The project manager is a key person to manage a health GIS project. This research aims to provide a framework to manage a successful health GIS project. The framework combines information system development methodologies with best practices in health GIS system development. The paper is organized in five sections. The first section is an introduction to the paper. The second section defines project management and system development processes. In the third section, the methodology of developing a framework to manage a successful health GIS project is described. The fourth section details the results and discussion. Finally, the paper concludes by giving some suggestions for the development of a health GIS project.

## 2. Literature Review

### 2.1 Project Management

Project management is "the application of knowledge, skills, tools and techniques to project activities to meet project requirements." (Project Management Institute, 2004). A project management process involves a series of four steps. These are: 1) Project planning – this includes devising and maintaining a workable scheme to ensure that the project addresses the organization's needs. It involves plans for scope management, schedule management, cost management, procurement management, communication management, and risk management. 2) Project execution – this includes coordinating human resources, cost, and other resources to carry out the various plans and produce the system. 3) Project monitoring and control – this includes regularly measuring and monitoring progress to ensure that the project team meets the project objectives. 4) Project closure – this includes formalizing the acceptance of the project and efficiently ending it.

### 2.1 System Development Model

To develop a system efficiently, it is necessary to apply a methodology. There are several methodologies of system development, for example the waterfall model, spiral model, prototyping life cycle model, and rapid application development model.

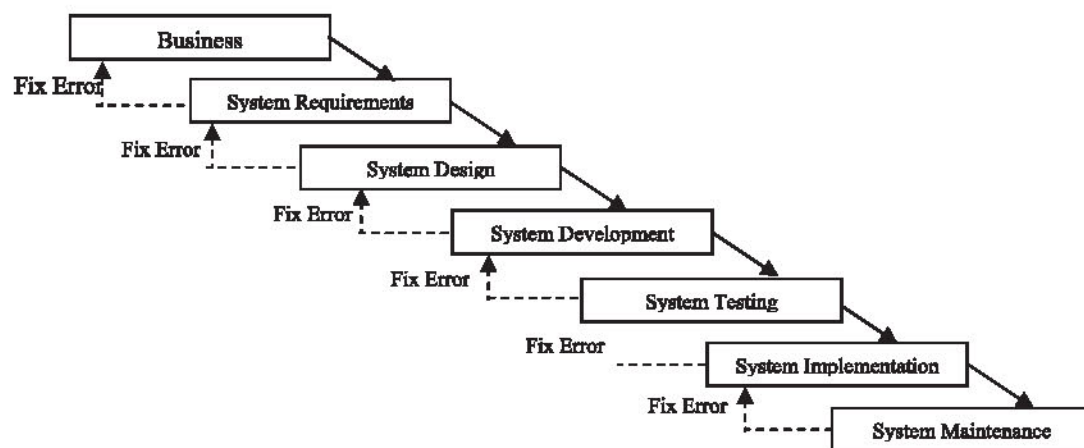


Figure 1: Waterfall model (Modified from Schwalbe, 2007)

- The waterfall model consists of seven stages. These are: business requirements, system requirements, system design, system development, system testing, system implementation, and system maintenance. Each of the stages can involve reversion to the prior stage if attempts at validation uncover problems (Schwalbe, 2007). The prototyping life cycle model is used for determining the requirements for the system. It is used for developing software prototypes to clarify user requirements. The developers can use the prototype model to generate system functions and design physical specifications. The prototype can enable the user to better understand the requirements of the desired system.

- The spiral model was developed based on the experience of various refinements of the waterfall model. It uses iterative prototypes. For each portion of the system, a risk analysis is performed. The steps include: 1) determining objectives, alternatives, and constraints, 2) identifying and resolving risks, 3) evaluating alternatives, 4) developing the deliverables for that iteration and verifying that they are correct, 5) planning the next iteration, and 6) committing to an approach for the next iteration (Hass, 2009).

- The rapid application development model allows for a greatly abbreviated development timeline compared to the other models. This model also allows for incremental testing and defect repair. Therefore, it involves significantly reduced risk (Hass, 2009).

### 3. Methodology

#### 3.1 Project Management for Health GIS Project

This section describes how to apply the concept of project management and system development model to manage a health GIS project. One of the key issues that will be addressed in this sector is: can the project management processes systematically help in developing a successful health GIS project? This study proposes a new direction in understanding health GIS project development through the project management processes. The project management processes are: 1) Project initiation: which includes recognizing and starting a new health GIS project. The organization must ensure that the right project is chosen for the right reasons. 2) Project planning: must be realistic and useful. In this process, the project management team must define the potential project, project scope, benefits and constraints. 3) Project execution: must ensure that the activities in the project plan are completed. Project control and monitoring need to be applied at this stage. 4) Project closure: involves submitting the developed system and gaining stakeholder and customer acceptance. The system development processes are: 1) System analysis: which involves the study of users' requirements. 2) System design: which is the process of designing the system functions, system database and user interfaces. 3) System development: consisting of program coding and testing. 4) System implementation: it entails the installation of the system and user training. 5) System maintenance: which involves making sure that the system continues to operate effectively and efficiently.



There are several areas of health GIS application development which include online health queries (ESRI, 2000), health planning (Ramasamy, 2006), health and disease analysis (Yagoub, 2011, Hassarangee, and Tripathi, 2011 and Jeefoo and Tripathi, 2011), and medical service (Ram Mohan Rao, 2010). In developing a health GIS system there are several processes: 1) data collecting, 2) map digitizing and geo-coding, 3) graphical user interface designing, 4) database designing, 5) program coding, and 6) program testing (Ram Mohan Rao, 2010 and Richards et al., 1999). Figure 2 illustrates the project management processes, system development methodology and health GIS project development processes.

### 3.2 Health GIS Project Development

A case study of a health GIS project development was chosen as the best means to illustrate how to manage a health GIS project by applying the proposed project management approach.

#### 3.2.1 System - Mission, Objective, Strategy

The mission of the GIS visualization system project was to develop a system for monitoring and controlling epidemic diseases in the North-East region of Thailand. Since there were several epidemic diseases spread around the country, the system was initially intended to enhance epidemic diseases control by providing a multi user GIS as a tool for data management, data analysis, data distribution, and data presentation. It was also expected to improve the accuracy of forecasts

through better control over data. For the project to be successful, it was important to get the support of the top level management team of the department. The top level management team will approve project budget, time for developing the project, and other resources for the project.

#### 3.2.2 System development

The Waterfall system development model was applied to develop the system project management strategy. The processes consist of: 1) System analysis is the study of user requirements. To develop a system to meet the users' satisfaction, it is important to understand the users' requirements in designing a health GIS system. This process can be done by using a questionnaire survey and in-depth interviews of the system's users. 2) Data preparation is the process to prepare spatial and non-spatial data. This process includes the map digitizing of provincial boundaries, district boundaries, roads, and geo-coding of village and hospital locations. 3) System design is the process of designing a graphical user interface, system functions, and database for the system. It is important to get the users involved in this process. 4) System development is the process of program coding and testing. 5) System implementation involves the steps to set up the system and give training to the users. Figure 3 shows the detailed development methodology. In this process the project manager is the key person to manage, monitor and keep the project on the right track.

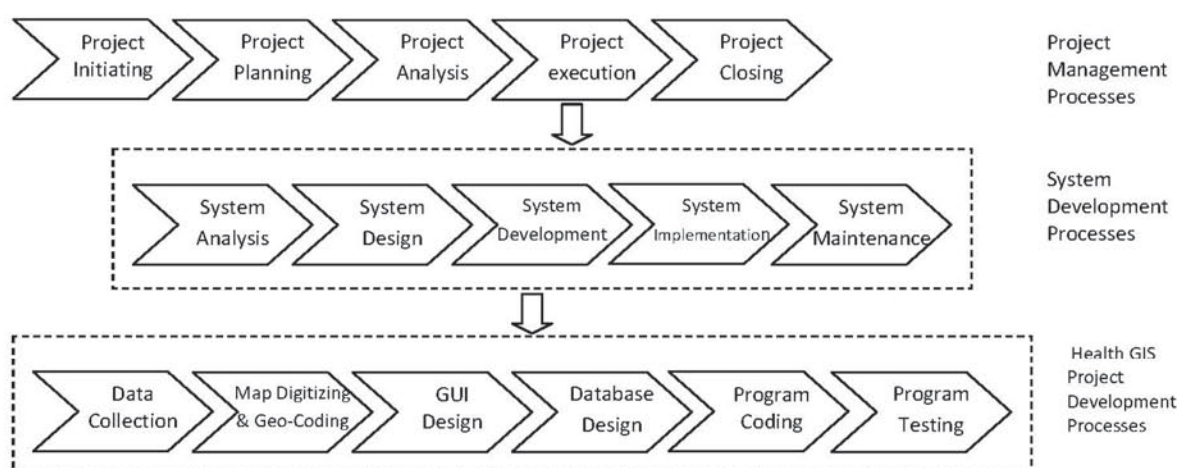


Figure 2: Health GIS project development processes

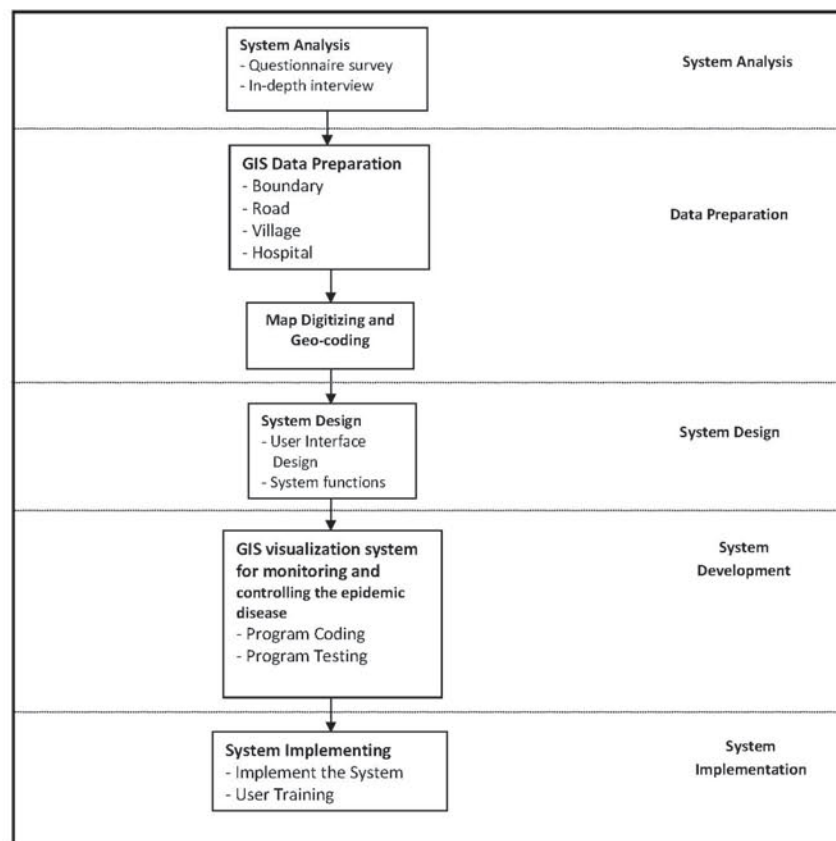


Figure 3: The development methodology of the GIS visualization system for monitoring and controlling epidemic diseases

### 3.3 Project Quality

The GIS visualization system project should be carried out according to the methodology proposed. The quality of the developed system is the most important issue in this project. The quality control processes should be applied during the system development. The quality control principle is Plan > Do > Check > Act.

### 4. Results and Discussion

The proposed project management approach for the health GIS project development is used to guide the project manager in managing, monitoring, and controlling the project. There are four criteria to measure a successful project. They are: the project must be on time, within budget, be of good quality, and meet user satisfaction. Using the proposed methodology is not a guarantee for a project to be successful but it does give guidelines and addresses many of the important issues for a health GIS project manager.

The proposed project management approach for the health GIS development is used to guide the project manager in management, monitoring, and control. It enables the identification of missing pieces of information, for example, the project plan and project risk control. In order to establish a good quality health GIS project, it is necessary to integrate the project into the organization strategy and get support from the top level management team (Birks, 2003). It is also important to make clear the objectives of project, user requirements, planning to identify and control the project risks, time management, and appropriate resources allocation to the project.

### 5. Conclusion

This study proposed a project management approach that combined project management strategy and the Waterfall system development model to establish a health GIS project. The proposed approach gave



guidelines and addressed many of the important issues for a health GIS project manager to facilitate management, monitoring, and control. It was important to identify the objectives of the project, users' requirements, plans to recognize and control risks, management of time, and allocation of appropriate resources. It was also necessary to integrate the health GIS project into the organization's strategies and obtain the support of senior management.

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