Bottom Up Approach and Devolved Design of a Health Information System: eHealth TABLET

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Abstract. Health care is expensive in the Philippines because of the lack of medical experts and facilities that are able to reach remote areas in the country. At the same time, access to real time health information is also undermined by several layers of paper based data entry. In areas where there are existing information systems, the burden is placed on the health worker in using several information systems to address various health concerns. This paper presents eHealth TABLET (Technology Assisted Boards for Local government unit Efficiency and Transparency), a local mobile (tablet-based) electronic medical record system and dashboard for decision making (coupled with a Doctor-Mayor communication feature) designed to answer problems in accessibility, efficiency and transparency following a bottom up approach and devolved approach in designing the system. As a local Electronic Medical Record (EMR) system, it provides the municipalities with a tailor-fit simple patient record system to better address the needs of their patients. As a health dashboard, it provides accurate and real-time visualizations of local patient data for decision-making purposes. As a messaging system, it provides a more efficient and transparent communication system between the Mayor (Local Chief Executive) and the Doctor (Health Officer).

Keywords: mobile health applications, design.

1 Introduction

ICT provides innovative venues for healthcare delivery, health research and collaborations with the least possible constraints such as time and space. More significantly, ICT presents ways of reducing inequities when it comes to accessing health-related needs due to geographic and financial barriers and improving the quality of care and consequently the quality of life, most especially in developing countries such as the Philippines. As a result, many health program implementers and policy makers are exploring the extent to which the use of the technology can help address the challenges faced by resource-constrained health markets in terms of the availability, quality, and financing of healthcare[1].

With the advent of modern information technology, health care systems are further strengthened with the integration of mobile and internet technology. To date, eHealth has been used to improve the health care delivery systems, public health, research, and other health-related activities of many countries in a broad range of applications. eHealth had definitely raised the expectations of the public on health information systems. Usability has been included in most, if not all, systems testing when there is a need to evaluate whether the system developed is being used for its intended purpose by its intended users. Slow adoption of ICT in the health sector may be because of one or more of the following reasons: "(a) few successful implementations, (b) high cost implementation, (c) lack of ICT advocates in the domain, (d) inconsistencies in standards and failure in interoperability, and (e) lack of priority by governments to use ICT, p.9."[2]. All reasons cited focus on entities external to the intended users of the system. To address these problems, solutions have been provided by both the private and the public sector. There has been a steady increase of development and use of health information systems in the country. As of this writing, the country has at least 120 health informatics systems as listed in the recent Galing Likha Kalusugan Awards sponsored by the Philippine Institute for Development Studies (PIDS) in partnership with Center for Health Market Innovation (CHMI) [4]. At the same time, as of March 2012, the inventory of health information systems on the Department of Health list include 26 health service delivery systems and 12 health regulatory systems [5]. These numbers show growing awareness of the need to use ICT in public health, however, there is still a need to see whether these systems actually lead towards efficient health care delivery.

Another aspect that is often used to address perceived failure in technology solutions is the adoption and acceptance of the system by its intended users. By adoption, we try to understand factors that produce high adoptors and at the same time laggards. By acceptance, we look into factors that explain a person's intention in using technology. For example, in a rural health unit, we have several stakeholders, including the rural health doctor, nurse, and midwife. At the same time, decisions are coordinated through the local government unit (LGU). Each user will have a different take on the use of the system depending on their role. A doctor uses the system to retrieve and view patient history. A nurse would encode data from paper based patient records. Midwives who are often on the field may compile individual patient data then submit it to the rural health nurse at the end of the week. One possible factor why the Philippines falls behind in adopting health information systems is because ICT is not a primary component of the professional training as medical doctors [3]. This is extended to the community as rural health nurses, midwives and health volunteers are technologically challenged to use multiple health information systems side by side with paper based forms.

While most systems deployed in local municipalities are designed at the national level with primary importance given to standardization of forms, our approach sets aside traditional methods in systems analysis and design. We present a bottom up and devolved approach wherein the intended users and immediate

stakeholders are the primary designers of the system. As such, we approach the problem of technology acceptance of health information systems by instituting an open approach in designing the system. We begin the story by providing overall context of the Philippine Health Organization. We also define approaches in designing health information systems in the Philippines from existing examples. We then present our present our bottom up and devolved framework which highlights the iterative, inter-agency, inter-municipality approach in defining the health information system that addresses acceptance, unification, efficiency and transparency.

2 Of Regions, Provinces, Municipalities: Organizational Context of the Philippine Health System

The Department of Health (DOH) is the key health sector steward in the Philippines responsible for the oversight of the health sector. The Secretary of Health is the head of the DOH. The Zonal Offices, located in Luzon, Visayas and Mindanao, are headed by an Undersecretary and supported by an Assistant Secretary. These offices are mandated to coordinate and monitor the National Health Objectives and the Local Government Code with the various Centres for Health Development (CHDs), which are responsible for the DOH field operations in their administrative region and for providing catchment areas with efficient and effective medical services. It is tasked to implement laws, regulations, policies and programs. It is also tasked to coordinate with regional offices of the other Departments, offices and agencies as well as with LGUs.

At LGU level, implementation capacity varies widely. What is common though is the overall organizational structure which follows the geographical divisions in the country. The smallest health unit is the Barangay Health Unit (BHU) manned by midwives and barangay health volunteers. The Municipal Health Unit (MHU) is the main LGU health department overseeing the health programs. It is called Rural Health Units (RHU) for municipalities and City Health Office (CHO) for cities. The staff is composed of a municipal or cith health officer, a public health nurse, medical technologist, sanitary inspector, a dentist and midwives. The Provincial Health Office (PHO) is the department coordinating with health programs for the province. Our design team is comprised of staff from the MHU, PHO, and DOH.

3 Methodology

The study involves several iterations of consultation with four main groups, namely: the mayor's office (mayor and staff), the local health office (doctor, nurse, midwife), the provincial and regional health offices (represented by their incumbent officers), and the main DOH Information Management representatives. Each consultation involved interviews which address the question: What will make the system useful and therefore, acceptable. Standard methods of data

gathering on user requirements included structured interviews, video recording of workflow, email correspondences, and informal conversations with intended users. For every iteration, mock up screens and prototypes were designed using an open source wireframing software that contained standard elements for tablets and mobile phones. Integrative workshops were also held were every stakeholder was present to agree on the final designs. Workshop materials included activities on technology acceptance, information flow diagrams, use of technology at work, and dashboard wish list.

4 Results

4.1 Bottom Up and Devolved Approach

In this section, we describe the steps in the bottom up and devolved approach in designing health information systems for local government units. Figure 1 presents a schematic diagram of the devolved approach.
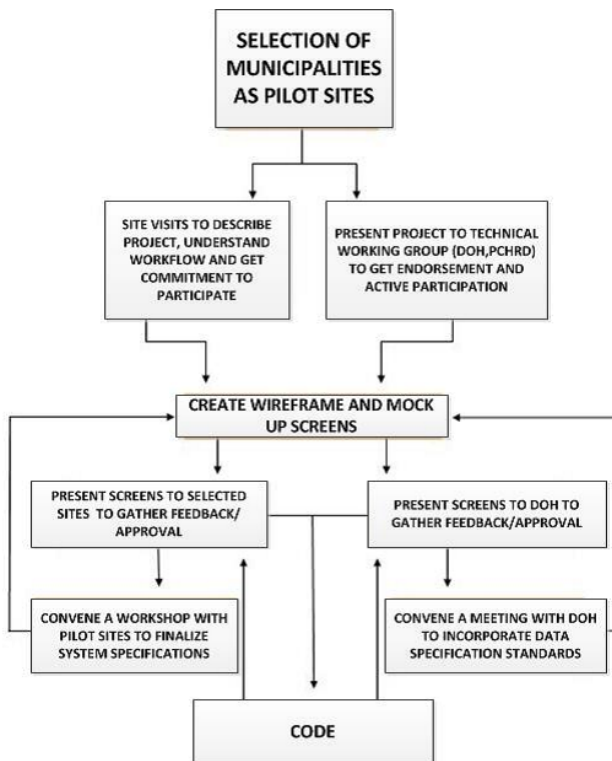

Fig. 1. Design Methodology using Bottom up and Devolved Approach

The first step consisted of discussion with the League of Municipalities of the Philippines (LMP) to provide an initial list of pilot sites following the criteria of both high and low adopters, and successful and unsuccessful implementations. From this initial list, two municipalities were selected. The next step was to conduct an initial visit to observe the workflow in the health center as well as interview key people regarding use of existing health information systems. The third step was to present initial mockup screens to selected municipalities as well as DOH Information Management Office. The fourth step was to convene a systems analysis workshop for both municipalities including representatives from the health government units. Parallel to the workshop, a presentation was also held with DOH to get endorsement and permission to use data standards. The fifth step was to provide another set of screens to concretize and get approval for the final design of the system. The iteration happens in the design, code, and most importantly in the presentation to the stakeholders.

4.2   Selected Municipalities as Pilot Sites

The two municipalities chosen as pilot sites in designing the health information system were Paombong, Bulacan and Anilao, Iloilo. Paombong is a third class municipality located in the province of Bulacan, comprising of 14 barangays and a population of approximately 50,000. The health center, located within the vicinity of the municipal hall, has a main staff consisting of two rural health doctors, a registered nurse and several health worker volunteers. The health center has two desktop computers and uses personal broadband sticks for internet connectivity. The nurse is computer literate and has undergone training in use of several DOH mandated health information systems. The staff expressed the need for computerization of the medical health records at the patient level, more than the required aggregate information required at the national level because the existing system provided by the government does not allow patient data entry. Instead, it requires aggregated form which then requires the staff to still do manual frequency counts per classification. The staff also highlighted on errors in data aggregation which leads to inconsistent information.

Anilao is a fourth class municipality located in the province of Iloilo, Visayas comprising of 21 barangays and a population of approximately 28,000. The health center, located in a separate lot a few meters from the municipal hall, has a main staff consisting of one health doctor, a registered nurse and several health worker volunteers. The municipal health team showed high adoption of ICT as the municipality boasts of development and use of internal information systems for transparency. The staff also expressed the need for a more efficient way to manage patient data.

Factors that influence technology acceptance for both municipalities include both perceived ease of use and perceived usefulness. Both municipalities identified standard workflow to include not only the rural health ecosystem but also included sending of regular reports to provincial, regional and national level. There is high use of ICTs within their work environment, but mostly for communication purposes more than health transaction processing. Preferred dashboards included

viewing of basic patient data in different chart formats and by location. There was also preference for use of tablets over desktop as tablets with 3G and wifi connectivity are becoming more affordable and accessible.

4.3   Evolution of the eHealth TABLET

The original concept of the eHealth TABLET framework (Version 1) was an integration of several health information systems for the LGU level by creating an integrated interface for both mobile device (tablet) and desktop computers. This interface serves to consolidate similar input specifications and then unobtrusively sends data to several information systems via webservices. The framework is supported in a cloud environment, where the data transmitted will be stored in the databases of the systems being integrated. Initial data gathering identified the Field Health Service Information System (FHSIS) and SPEED (Surveillance in Post Extreme Emergencies and Disaster) as the health information systems that were integral to their work process. The original framework evolved to its second version after consultation with DOH, specifically regarding the connectivity protocols with DOH. The second version was designed to pull data from the DOH connection facilities, without pushing data inward (no inputs) to the connection facilities. While the DOH is preparing the standards for interoperability, the current design is based on approved DOH specifications as well as meeting requirements of its primary users. Figure 2 presents the evolution of the design framework for eHealth TABLET. The eTABLET product is largely a patient record system with status reporting system in the form of a dashboard (with maps, graphs, reports, etc.). Figure 3 provides sample screen shots of eHealth TABLET v.3.

The electronic medical record is locally managed by municipality. Data entry and viewing is done via the tablet. Individual patient data is sent to a secured cloud service. Web services include data aggregation. The dashboard pulls data from the cloud. To remain aligned with DOH needs and specifications, the system is designed to connect to DOH databases for push and pull of data. The latest version of the eHealth TABLET is a combination of a mobile Android-based Electronic Medical Record system, a visual dashboard visualization of local health information, and a communication system between rural health officer (i.e. the doctor), and the Mayor.

5   Insights in the Bottom Up and Devolved Approach

Current approaches in technology acceptance discuss factors on perceived ease of use and perceived usefulness and their corresponding sub factors but fail to take a step back and look at acceptance as a design issue. In this study, the immediate users see the system as important in providing an electronic version of their patient records. The mayor sees the system as useful in making decisions that are grounded on accurate and real time data. The secondary users (provincial and regional officers) see the system as important in collecting
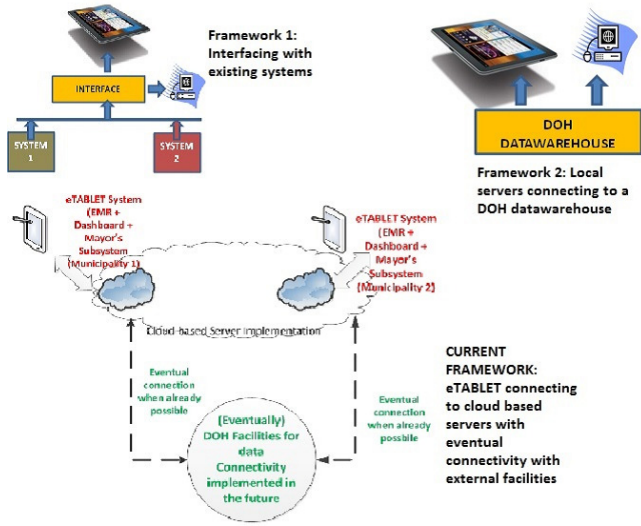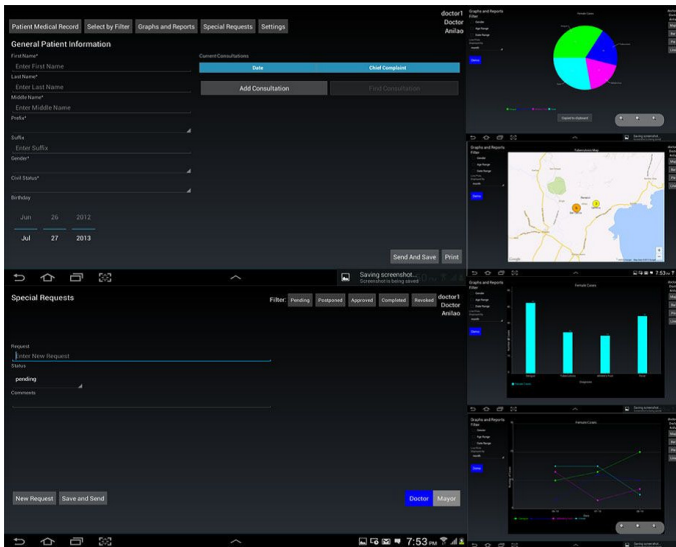
Fig. 2. Framework of eHealth TABLET

Fig. 3. eHealth TABLET Screens

aggregate information that needs to be submitted to the national office. The tertiary users (Department of Health) sees the system as a way to generate accurate and real time data and at the same time requires the system to be interoperable with future DOH systems. Participatory approach in the design of health information systems proved to be an important factor in the acceptance of technology. More specifically, bottom up and devolved approach means inclusion

of all stakeholders including intended users of the system at the data entry level (nurse, doctor, midwife) and at the decision level (doctor, mayor, DOH). An inter-agency approach also allows for each user to understand the needs of the other users. Lastly, the devolved approach provides the intended users with ownership, not only of the data, but of the system thereby increasing the chances of technology acceptance in the end. It is a known fact that designing systems is very much client dependent. However, the dilemma often stems from differentiating the client, the one who pays for the system and the real client, which is the user of the system. Another concern is that needs to be addressed is that health information systems, by nature, are not stand alone systems. This means that information coming from one system is useful in another system. In this paper, we present a design approach that looks into the microsystem and macrosystem. At the micro level, designing the system tailor fit to its primary users provides motivation to actually use the system as an integral part of their work. At the same time, designing the system that responds to the needs of users at the macro level its usefulness to the macro level where decision making relies on accurate, efficient and transparent information.

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