# Information Technology Assessment on Hospital Information System Implementation: Case Study A Teaching Hospital

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*Abstract*— **Currently, hospitals are required to improve their quality of health services to meet the higher standards. This improvement is supported by Ministry of Health which has launched electronic health (e-health) program. Under this program, hospitals are required to have Hospital Information System (HIS) or Enterprise Resource Planning (ERP) for healthcare. However, to date only a few hospitals have implemented an integrated HIS. The purpose of this research is to asses the Information Technology (IT) maturity of a teaching hospital in implementing HIS. This IT assessment observes from four layers namely business process, Information System (IS), Information Technology (IT) and IS/IT management and organization. The result of this research is that teaching hospitals should prepare a plan to restructure their network with adequate infrastructure, create IT blue print and policy, IT organization restructuring, IT staff competency development and build integrated HIS.**

**Keywords-Hospital Information System, Teaching Hospital, IT Assessment**

## I. INTRODUCTION

In order to provide excellent health services, hospitals should be equipped with Hospital Information System (HIS) to automate their business processes. Based on Law No. 44 of 2009 regarding Hospital, hospital is defined as a health care institution that organizes the complete individual health care that provides inpatient care, outpatient, and emergency room. Also, in conducting health care, a hospital should provide administrative services. Both of those services data will be managed in HIS. HIS is an integrated information system to handle the entire process of hospital management starting from registration process, medical and medicines services, as well as its internal services such as employee data management, finance and procurement.

Based on Minister of Health Regulation No. 1171 of 2011 regarding Hospital Information System, in order to improve health services in Indonesia, the Indonesian government through the Ministry of Health has launched electronic health (e-health) program. Under this program, all hospitals are required to have a Hospital Information System (HIS) or Enterprise Resource Planning (ERP) system for healthcare. HIS is also required to send report to the Ministry of Health which includes data on hospital identity, human resources (doctors, nurses, and medical staffs), summary of health services activities and compilation on disease or morbidity inpatients and outpatients.

During the year of 2005-2009, the number of hospitals grew approximately 20.8% [1]. Based on Law No. 44 of 2009 regarding Hospital, hospitals in Indonesia are classified as follow:

- General hospital: deals with many kinds of disease and injury, and normally has an emergency department

- Specialized hospital: deals with specific medical needs such as psychiatric problems, certain disease categories such as cardiac, oncology, or orthopedic problems

- District hospital: is the major health care facility in its region with intensive and long-term care

- Teaching hospital: combines assistance to patients with teaching to medical students and nurses and linked to a medical school, nursing school or university

- Clinic: is the medical facility smaller than a hospital and generally provide only outpatient services

This research uses a teaching hospital as case study due to its business processes complexity which covers not only health services but also health research services in Indonesia. Today there are 39 official teaching hospitals in Indonesia which have been accredited by the Ministry of Health. Until year 2012, there are only several teaching hospitals that have implemented HIS namely RSUP (Central General Hospital) Sanglah, RSUP Dr.

Hasan Sadikin, RSUP Dr. Cipto Mangunkusumo, RSU (General Hospital) An-nisa Tangerang, Rumah Sakit Khusus Gigi dan Mulut Kota Bandung (Dental Hospital of Bandung), and RSUD (Regional General Hospital) of Kabupaten Panajam Paser Utara, East Kalimantan Province [2]. Furthermore, HIS development is quite complex considering the organization is multi-functional, complex and information intensive. Characteristics of the hospital led to the need for integration, especially for payment, laboratory medicine and patient medical records can be used in a single workflow [3] [4].

In order to provide guideline to teaching hospitals for preparing the steps that should be conducted before implementing HIS, this paper discusses IT assessment of current conditions in a teaching hospital and provides solutions as a roadmap to implement HIS. The contribution of this paper is to provide an IT guideline for the teaching hospitals before implementing HIS.

The remaining of the paper is organized as follow. Section 2 explains the previous works, while the research methodology explained in section 3. Analysis of the current conditions of this teaching hospital as well as the road map recommendations before implementing HIS are discussed in section 4. Final section discusses the conclusions and future works of this research.

## II. PREVIOUS WORK

There are several studies related with analysis and design of several modules in HIS. Study from Purwanto concluded that a hospital required IS/IT strategic planning to increase hospital competitive advantage [8]. In order to be succeed in implementing HIS and integrating several applications in certain hospital, a study from Rufaida designed enterprise architecture for hospital using TOGAF (The Open Group Architecture Framework) with case study a private hospital in West Java [9].

Study from Setiawan designed inpatient module for a clinic in Magelang Regency to manage patient, room, action, diseases master and transaction data as well as reporting [5]. Rahayu implemented radiology module for a hospital in Salatiga [6]. In addition, study from Rika delivered laboratory module for a teaching hospital using total architecture synthesis [7].

## III. METHODOLOGY

There are several steps were taken in this study, namely creating list of problems, conducting root cause analysis using fishbone diagrams, problem analysis and provide recommendations. Collecting current problems and issues are completed by conducting desk top study (i.e. HIS standard operating procedure, user and technical documents, etc.) related with HIS and IT governance (i.e. IT job description, etc.), interviewing HIS users and HIS staff personels which are in IT division, and observing and testing current HIS infastructure. Then, those problems will be categorized into 4 layers in fishbone diagrams as follows:

- Business Process Layer: consists of list of problems related with business processes and policy
- IS Layer: includes list of problems related with the applications
- IT Layer: consists of list of problems related with infrastructures (i.e. server, network,  security, etc)
- IS/IT Management & Organization: includes list of problems related with organization governance and human resources

Next, problem analysis will be conducted with prioritizing problems by identifying its level of risk. Determining the level of risk is done by identifying a series of impacts and its appears of those impacts. Those identified impacts could happen now and in the future. Each impact and its appears frequency should be scored and divided into High (score equal three), Medium (score equal two) and Low (score equal one). Priority issues are determined by the sum of results of impact assessment of the value multiplied by the frequency of occurrence. Finally, recommendations to address any problems that could exist will be developed from the results of the analysis.

## IV. ANALYSIS

Based on our analysis, there are several problems that have high risk and should be urgently solved by teaching hospital (Table 1). Due to lack of IT skills and knowledge, this hospital has a very high dependence on certain vendor which cause most of the problems occurred could not be handled on time and not in accordance with the target. According to Table 1, the highest risks are come from IS and IT layer where this teaching hospital urgently should establish their internal helpdesk and restructure their network by improving their IT support infrastructure and implementing network security system such as firewall, etc. in parallel. Other immediate activities that should be done to create a good IT planning is to formalize IT blue print and policy for defining short and long-term IS/IT planning. IT policy should also be formalized to create standards in this teaching hospital. In addition, from IS Layer, HIS should also be upgraded or renew in order to be integrated with other systems.

Finally, IT organization restructuring should also be conducted to formalize roles and responsibilities of IT division in this teaching hospital in accordance with the international best practice. Subsequently, IT staff competency development should also be conducted to increase their IT skills and knowledge by conducting training, seminars and providing with adequate IT literature books or journals.

TABLE I
List of Problems with Its Related Impact

| Problem Area | Problem | Impact | Impact Score (I) | Frequency (F) | Risk Score (SUM (I x F)) |
|---|---|---|---|---|---|
| **BUSINESS PROCESS LAYER** | | | | | |
| Policies formalization | Lack of IT staff competence in determining policy regarding vendor management | Activities are done currently ad-hoc (not in accordance with the plans that been made) | 3 | 3 | 9 |
| **IS LAYER** | | | | | |
| Information Architecture Standard & IT Policy | Minimum service standards are not clearly defined | - Difficulty in monitoring performance | 2 | 2 | 47 |
| | | - IT services does not meet user expectations | 3 | 3 | |
| | | - The gap between the expectations of the capabilities possessed | 3 | 3 | |
| | | - Deviation / performance decline was not identified in a timely manner thereby affecting business operations | 2 | 2 | |
| | | - The difference in interpretation / misunderstanding of the IT services provided | 2 | 2 | |
| | | - Disproportionate prioritization of services | 2 | 2 | |
| | | - Failure to identify and respond to critical services | 3 | 3 | |
| | | - Resource allocations that are not effective and efficient in the provision of IT services | 2 | 2 | |
| IT Problem Management | Problem handling is not on time and target | - Low level of user satisfaction | 3 | 3 | 57 |
| | | - Problems addressed are still recurring | 3 | 3 | |
| | | - There is no problem tracking process | 3 | 3 | |
| | | - There is no prioritizing of incidents according to business needs | 3 | 2 | |
| | | - Problems are not handled on time | 3 | 3 | |
| | | - Unavailability helpdesk resources as needed | 3 | 3 | |
| | | - Helpdesk could not fill in business needs | 3 | 2 | |
| | Existing application features are not yet perfect | - Hampered operational activities | 3 | 3 | 45 |
| | | - Failure to identify and respond to critical services | 3 | 3 | |
| | | - Difficulty in monitoring performance | 3 | 3 | |
| | | - IT services does not meet user expectations | 3 | 3 | |
| | | - Disproportionate prioritization of services | 3 | 3 | |
| **IT LAYER** | | | | | |
| Network security | Abuse of accessing devices and computer network services | - Threats to critical infrastructure and services | 3 | 3 | 27 |
| | | - Threats related to data integrity | 3 | 3 | |
| | | - Threats of misuse of information (such as user password) | 3 | 3 | |
| Network reliability | Network topology | - High processing load on network devices | 3 | 3 | 18 |
| | | - Network instability | 3 | 3 | |
| | Inadequate infrastructure facility | - Network instability | 3 | 3 | 36 |
| | | - Threats to critical infrastructure and services | 3 | 3 | |
| | | - Damage to the infrastructure due to electrical problem | 3 | 3 | |
| | | - Damage to the infrastructure due to temperature and humidity | 3 | 3 | |
| | Unavailable network management | - Slow response to network problems | 3 | 3 | 9 |
| **IS/IT MANAGEMENT AND ORGANIZATION** | | | | | |
| IT organization | Structure of the roles and responsibilities of IT is still not well defined | - Hampered operational activities/services | 3 | 3 | 18 |
| | | - IT organization become unresponsive | 3 | 3 | |
| | The number of operational issues that can not be resolved by IT staff | - Hampered operational activities/services | 3 | 3 | 18 |
| | | - IT organization become unresponsive | 3 | 3 | |

## V. Conclusion and Future Works

Teaching hospitals as a public institution should have an excellent services to society. In order to achieve this goal, they need to be equipped with an integrated HIS due to their complex business processes as health and research services institution. With a working HIS, teaching hospital could handle the entire process of hospital management starting from registration process, medical and medicines services, as well as its internal services such as employee data management, finance and so on. However, there are several problems that are faced by teaching hospitals such as inadequate infrastructure and application, no formalized IT planning and related policy, structure of the roles and responsibilities of IT is still not well defined and lack of competence of their IT staffs. To overcome these problems, teaching hospitals should prepare a plan to restructure their network with adequate infrastructure, create IT blue print and policy, IT organization restructuring, IT staff competency development and build integrated HIS. The future works of this research are identifying the critical success factors needed when implementing HIS and knowing hospital business processes in more detail.

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