

Formulating cloud based hospital information system (HIS) with Zachman framework

Wang Gunawan*, Bellarika Liejaya

Information Systems Management Department, BGP-Master of Information Systems Management, Bina Nusantara University, Jakarta, Indonesia

*gawang@binus.edu

Abstract. Information Technology and System (IT/S) has become essential components in the companies in various focuses and fields. Major Indonesian companies experience difficulties to link the business objectives with IT implementation, that lead to creating major problems, such as: ineffective IT investment, major complaints amongst potential stakeholders, etc. The article takes the case study of one of the largest hospital chains, XYZ Hospital that has 21 subsidiaries operating in major cities in Indonesia. Currently, The XYZ hospital has cloud-based computer system that integrates entire business processes in Hospital Information System (HIS). Due to its all advance computer systems, ironically, the HIS receives many complaints and dissatisfaction amongst major stakeholders of the hospital. The director has risen the issue to evaluate the current HIS development. For this reason, the article proposes the popular Enterprise Architecture, Zachman framework to assess the current business process in the organisation. To simplify the discussion, the framework is simplified to the essential component of 3x3 matrix, and links them with 3 important stakeholder's perspectives of HIS development: planner (scope), owner (enterprise model) and designer (system model). The outcome is expected to provide reference for those important stakeholders for further HIS development.

1. Introduction

The role of Information Technology and System (IT/S) in the modern company era is undoubtedly important. It drives to the integration and the investment of IT/S into organisational planning process, even possibly the alignment of these two to the business goals (1). The IT/S starts by formulating the company IS objectives (business goals that have been aligned with IT and IS), defining some initial strategies and policies and as well as developing detailed plans to achieve the IS objectives. The application of IT/S can be found in various companies with different focuses and fields. One of them is a hospital, where the comprehensive IT/S enables to improve the entire computer system within the hospital management system (2).

XYZ hospital is one of the largest hospitals in Indonesia that operated with cloud networks to connect all 21 subsidiaries all over big cities in Indonesia. With cloud networks, all major stakeholders of the hospital such as: directors, managers, physicians and staffs enable to collaborate and exchange essential data. The Hospital Information System (HIS) is created to facilitate that collaboration and manage entire business processes in all hospitals. With the large number of subsidiaries, HIS is expected to deliver the best services to those all parties and premium patients. Large amount of money and great efforts have been spent in developing HIS to serve all subsidiaries, However, due to tremendous resources that have been spent to develop HIS, those major stakeholders are still unsatisfied with HIS

performance. They address that HIS is hardly to use (not user-friendly), and some important features are not fully available (e.g. help, reporting and sorting features, and other supporting features). Moreover, they also address HIS has long processing time and the data is not updated regularly. Hoo and Huady [3] examine developing HIS requires special attention from top management, and it involves complex tasks with high expectations come from all directions [4].

To improve the performance of HIS and overcome its problems, the article applies popular enterprise architecture, Zachman framework [5] that has been applied in many large enterprises. In order to simplify the discussion, the article takes important parts of the framework, 3x3 matrix and link them with essential stakeholders that involves in HIS development. They are: the planner of HIS (scope), owner of the task (enterprise model), and designer of the system (system model). The outcome of the article is expected to provide reference for HIS developers and hospital management to examine the current advance computer systems that have connected with cloud networks.

2. Literature Review

2.1. Hospital Information System (HIS).

Hospital Information System (HIS) is defined as an integrated electronic system that collect, store, retrieve and display overall patients' data and information such as history of patients' information, results of laboratory test, diagnoses, billing and others related hospital's procedures which are used in several departments within hospitals. It is important in the health-care industry as it supports a wide range of highly specialized health-care tasks and services.

2.2. Cloud Computing.

Cloud computing is a style of computing where computing resources are easy to obtain and access, simple to use, cheap, and just work. Cloud is not a point product or a singular technology, but a way to deliver IT resources in a manner that provides self-service, on-demand and pay-per use consumption (9). The requirements for cloud computing are increasing, owing to its high efficiency in time and energy, flexibility in data access, simplicity and ease of use, and ease of maintenance (10).

2.3. ISA Zachman Framework.

Enterprise architecture refers to the structure of an enterprise, its decomposition into subsystems, the relationships between the subsystems, the relationships with the external environment, the terminology to use, and the guiding principles for the design and evolution of an enterprise (6). Enterprise architecture focuses on shaping and governing the design of the future enterprise using principles to stipulate future direction and model to underpin and visualize future states (7).

Table 1. Zachman Framework.

	What	How	When	Who	Where	Why
Executive						
Business Management						
Architect						
Engineer						
Technician						
Enterprise						

Zachman framework introduced the first and best-known enterprise architecture framework as it applies to enterprises is simply a logical structure for classifying and organizing the descriptive representations of an enterprise that are significant to the management of the enterprises as well as to the development of the enterprises systems (8). Zachman Framework consists of 6x6 bounded matrix (see Table 1) where the columns depict the fundamentals of communication or primitive interrogatives, namely what, how, when, who, where and why. The rows represent different perspectives on the enterprise from the viewpoint of different stakeholders. The perspectives are from executive, business management, architect, engineer, technician and enterprise perspective. This framework distinguishes each stakeholder's perspective of the enterprise and shows how to incorporate all the stakeholders' perspectives into the understanding of an enterprise (6).

3. Research Method

The article applies qualitative-based study with the aim to explore comprehensive understanding to the current HIS in cloud network hospital. The data gathering methods comprise of observation, interviews and focus group discussion to major stakeholders of the hospital such as: all physicians, managers and directors that involve in using HIS. The findings are verified against respective journals related Enterprise Architecture that retrieved from Association for Computing Machinery (ACM), Association for Information Systems (AIS), Google Scholar, and IEEE. The outcome is expected to provide insight of assessing the entire business process in HIS, especially with reporting system that commonly addressed to HIS.

The application of Zachman framework is expected to provide reference to managing complex business processes addressed to HIS development. Due to complexity of applying Zachman framework, the article simplifies the framework into 3x3 matrix, according to 3 major perspectives that required by top management of hospital: planner (scope), owner (enterprise model) and designer (system model). Those three perspectives later are combined with dimension of data (what), function (how) and network (where), to map missing domain in HIS development plan.

4. Findings and Discussion

Based on the observation, interviews and focus group discussion, the findings are summarised into:

4.1. Scope.

Scope addresses the perspective of planner to define the enterprise direction and goals in HIS. This perspective is divided into three perspectives: (1) data (What), explains the object related to HIS, that comprises of upgraded reporting module and the use of cloud computing in upgrading the HIS modules; (2) function (How), explains any process that is done by HIS such as: generate reporting. This process can be done by any department in XYZ hospital within the specified period to generate report; (3) network (Where), explains the location of where the HIS system is. Currently all XYZ hospital chains are connected through cloud based HIS networks as software as a service (SaaS).

4.2. Enterprise Model.

Enterprise model explores the scope that discussed in 4.1 in enterprise setting. Enterprise model captures the entire network architecture and logical structure of HIS. The 3x3 matrix

row explains the system from the owners view in the XYZ Hospital: (1) data (*What*): In this data column, every object in data will be detailed based on owner's perspective. In Figure 1 below, there are each object is related to other object; (2) function (*How*): This column will explain the interaction of every actor (user) towards the reporting system. Figure 2 shows the relationship and interaction between actor (user) and system where there are 11 different actors that can generate their own report data; (3) network (*Where*): Network column in enterprise perspective will show the network for XYZ hospital. Figure 3 is shows that there are 11 departments that can use the system to access the data.

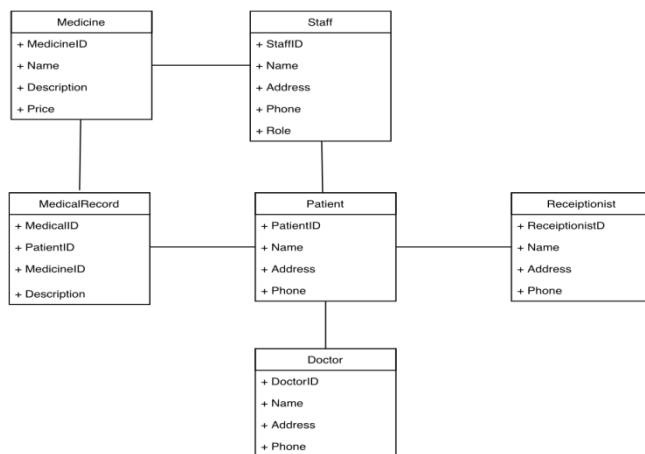


Figure 1.Class Diagram of XYZ Hospital Reporting System (Owner's View)

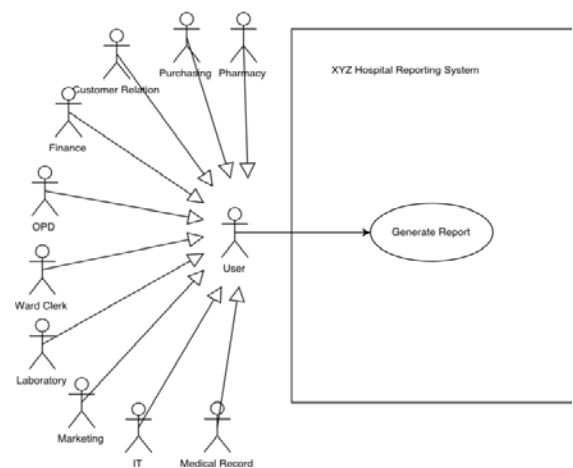


Figure 2.Use Case Diagram of XYZ Reporting System (Owner's View)

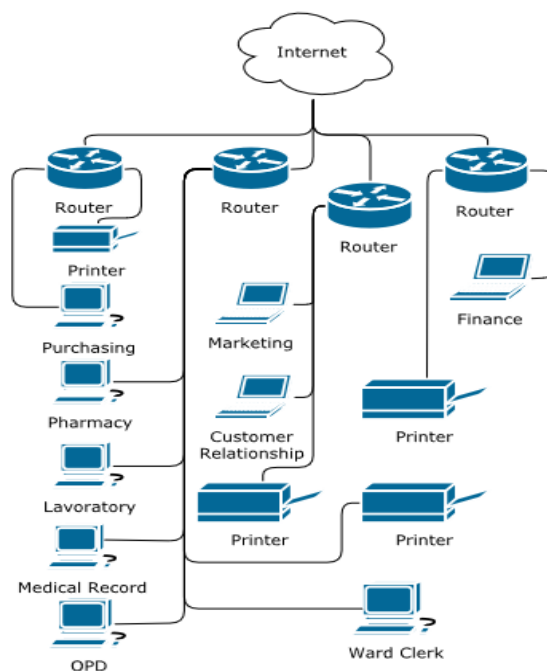


Figure 3.Network Architecture of XYZ Hospital

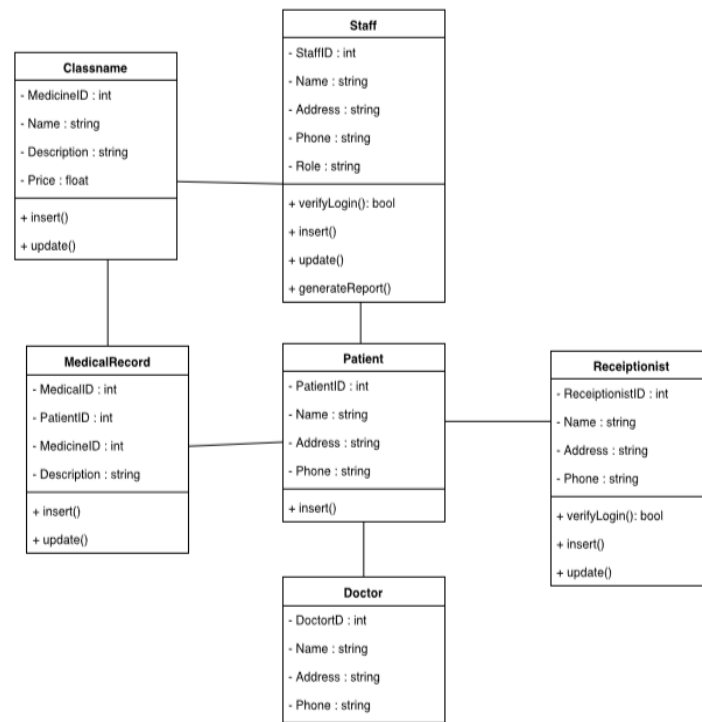


Figure 4. Class Diagram of XYZ reporting system (Owner's View) Hospital Reporting System (designer's view)

4.3. System Model

This row explains the system from the owners view in the XYZ Hospital such as: (1) data (*What*), explains the detail of every object based on enterprise model using class diagram. Figure 4 illustrates detailed information of each object in the system. There are 6 classes with their own attributes and the function they can do with the system; (2) function (*How*), explains the interaction of every actor (user) towards the reporting system using use case diagram. Figure 5 shows the relationship and interaction between actor (user) and system. Before the actor can use the system (generate the report), user must do some required activity first. Login to verify their role and identity, if pass, user can select the range of date they need. User can also filter the data they need to be reported. After they finish the requirement, user can generate their report: (3) network (*Where*), shows HIS' users in the network for XYZ hospital's reporting system through using cloud based network diagram. Figure 6 shows all components of HIS network. There are nine departments are connected with HIS system within four areas. Each area can access its own file servers to ensure the security of the data.

With the legacy system, HIS runs on the premise server, which has a higher risk and limited access within organizational boundaries. With cloud computing concept, each application in HIS system is being deployed in cloud system, and the processing time is claimed to run faster and minimum data redundancy as occurs before.

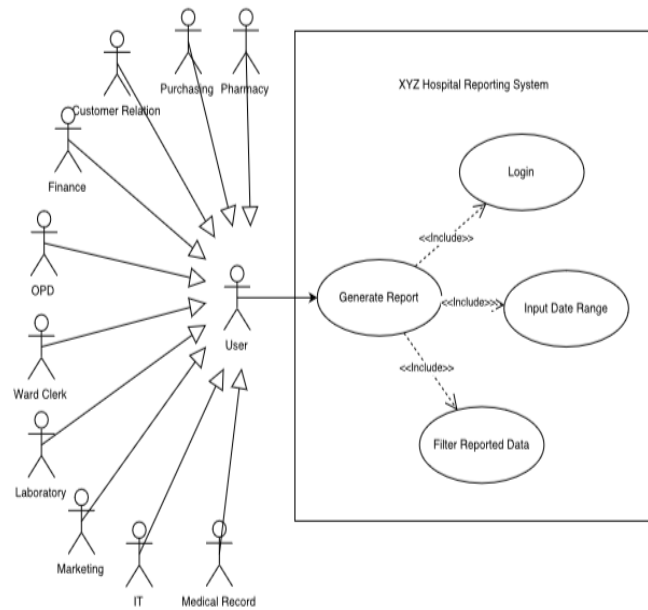


Figure 5. Use Case Diagram of XYZ Hospital Reporting System (Designer's View)

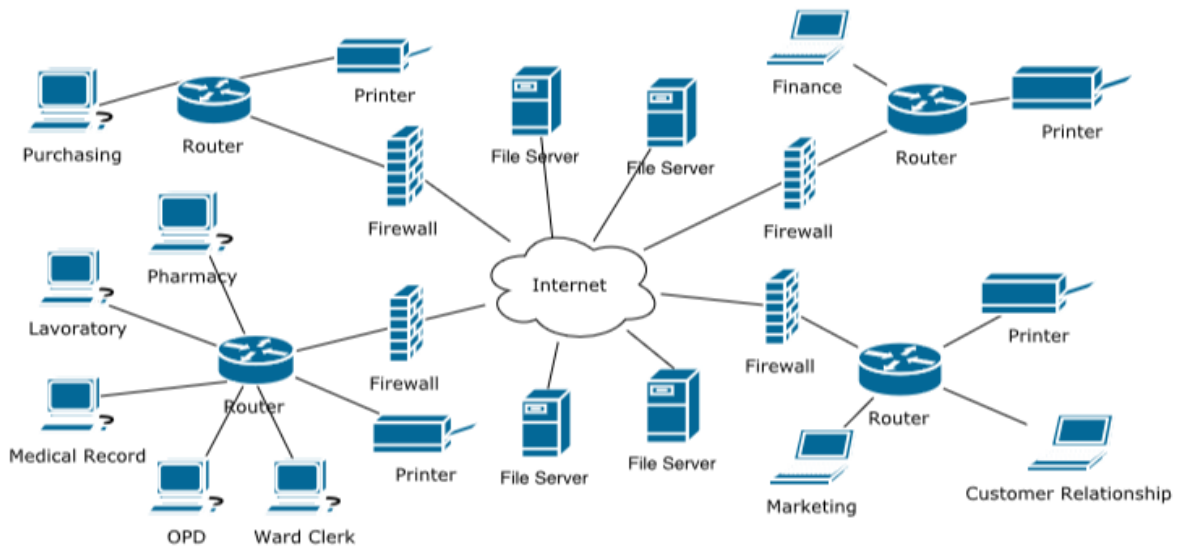


Figure 6. Network Architecture of XYZ Hospital Reporting System (Designer's view).

To minimize data redundancy, the new proposed reporting module does not have a database, instead of utilising it from other independent modules that is specified in layer Independent Module. In accessing this information, the reporting module sends a request to services (in layer API Service) which provided by other independent modules. Then, the independent module will use basic database function CRUD (Create, Read, Update, and Delete) to retrieve the information from its own database (in layer Database). Finally, after the data has been retrieved, each independent module will forward the information back to reporting modules through its services as a response.

5. Conclusion

This paper proposes the use of Zachman framework and cloud computing to address the common problems faced by HIS in XYZ hospital. Current HIS unable to map the different expectations of stakeholders such as directors, managers and physicians. As a result, there are major complaints addressed to the HIS development. The article takes simplified Zachman framework with 3x3 matrices with the aims to provide reference to understand and map those different expectations. The article focuses on the common problems such as reporting system in HIS networks and preparation to review the HIS development plan.

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