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Better Healthcare: Exploring Business Intelligence for Healthier Malaysian Rural Dwellers

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Abstract

Healthcare in the rural areas have been encountering decision making issues which are due to the lack of maximising the use of their historical data. It is a general believe that many of healthcare data together with strong analytics by business intelligence brings about proposition for attainment of community healthcare success. This study intends to explore and analyse the phases leading to the business intelligence requirements for strategic decision in healthcare organisation in rural healthcare in Malaysia. Thus, goal-oriented approach and Requirements Management Control methodology are employed, leading to the requirement analysis model for Malaysian rural healthcare.

Keywords Business Intelligence, Rural Healthcare, Goal Oriented, Requirement Analysis, Requirments Management Control

1. Introduction

Many of the healthcare centers today have been upgraded to the extent that they are making use of the electronic health record systems which combine both clinical and administrative data in its operations. Despite the advancement in the healthcare centers operations, healthcare delivery is currently facing some challenges caused by the technique in collecting the data for analysisng their performance at the end of the day. It is posited that healthcare organizations can take advantage of this data and explore analytics as a competitive tool provided by a concept called BI as a method to help provide better care, improved outcomes and safer, more effective decision making [2]. Taken together, systems and data cannot solve all of the problems face by healthcare system alone. This requires an eye toward setting the strategy based on sound fundamentals along with policy decisions that govern the operations of healthcare environment. Hence, exploring and understanding healthcare requirements from BI are vital in order to achieve the goals.

This study attempts to explore the phases needed for the BI requirements to achieve the strategic business decisions in Malaysian rural healthcare centers. How data and analytic can provide the much needed backbone to support improvements critical to achieving long term success for community healthcare is the centre of the study. In the turmoil between costs, care-results and patient satisfaction the right balance is needed and can be found in BI. Forward-thinking healthcare organizations have realised that BI is mainly useful for making a managerial decision in their domain, ensuring their organiation's future. In other word, absence of program in place to target, gather, deliver and analyze the most relevant data, these organizations is forecasted to be rich and become information poor.

2. Healthcare and information

Healthcare organizations (HCO) are information-intensive enterprises [4]. Healthcare personnel require sufficient data and information management tools to make appropriate decisions. Clinicians assess patients' status, plan patients' care, administer appropriate treatments, and educate patients and families regarding clinical management of various conditions. Primary-care physicians and care managers assess the health status of new members of a health plan. Medical directors evaluate the clinical outcomes, quality, and cost of health services provided. Administrators determine appropriate staffing levels, manage inventories of drugs and supplies, and negotiate payment contracts for services. Governing boards make decisions about investing in new business lines, partnering with other organizations, and eliminating underutilized services. Collectively, healthcare

professionals comprise a heterogeneous group with diverse objectives and information requirements.

The main objective of HCO is to reduce operating costs while maintaining a consistently acceptable level of patient treatment. Reducing operating costs means (1) cost of healthcare Professionals (2) cost of lab equipment and consumables (3) cost of pharmaceuticals/medical material (4) cost of a treatment per diagnosis (5) cost per type of medical intervention. Meanwhile, an acceptable level of patient treatment involves (1) evidence based medicine, accurate diagnosis and efficient treatment (2) on time admittance in the hospital and healthcare treatment (3) treatment with respect for the patient- analysis of options (4) reduction of risks during treatment (5) capture of medical history of the patient in to support evidence based medicine.

2.1 Malaysian Rural Healthcare

The consumers of rural healthcare in Malaysia are mainly those whose purchasing powers are very limited and they are dependent of free public services. Today, most of them have limited choice of accessing other provider of healthcare which includes private hospitals which may offer better product and services. However, the rural dwellers in Malaysia show less demands and lower expectations to the rural healthcare services provided by the government due to insufficiency of quality services [1]. The healthcare delivery in rural areas has been facing a continuous challenge due to a shortage of healthcare professional [11]. The posting and location of healthcare professional have been widely seen in the urban and wealthier areas [7], leaving rural dwellers in average sicker, poorer and worse access to healthcare when comparing with people in urban areas. The present challenge by Malaysian rural healthcare shows that the rural dwellers healthcare's needs are facing worst access to healthcare services [9].

The successful implementation of rural healthcare in Malaysia requires competence and professional benchmark which embedded being-patient in the values and behavior. The rural healthcare staffs in Malaysia have witnessed upgrading in knowledge and skills to sustain the right value and attitudes. One of the contemporary issues bordering Malaysian rural healthcare is the number of health workers and their distribution [11]. The issue of distribution of experience and skillful healthcare professionals in Malaysian rural areas can be tackled by applying BI as a measure. The disadvantaged and marginalized groups in the rural areas need to be alleviated in achieving successful rural healthcare services in Malaysia [7].

3. Business Intelligence

BI is coined by the Gartner group in the mid 1990s from the area of management information system reporting systems of the 1970s. During the introduction of BI, the reporting systems were static, having two-dimensional features and had no analytical capabilities. In early 1980s, the concept of executive information systems (EIS) was emerged by expanding computerized support to top-level managers and executives. The EIS concept consists of dynamic multidimensional reporting systems, forecasting and predicting, trend analysis, drilling down to details, status access and critical success factors, while all of these features leaved to the mid 1990s. BI evolved with the existing capabilities, but built of the EIS with few features and believes that all information needed by the executives can be in a BI-based enterprise information system. In the year 2005, BI system started to include artificial intelligence and powerful analytical capabilities [8]. BI tools and methodologies have the following characteristics as described in Table 1.

Table 1: Characteristics of BI [8]

Characteristic	Description
Access to information	Flexible and allows end users to gain access to data regardless of the source of data
Support decision-making	Presents the information and gives access to analysis tools that will allow the users to select and manipulate data that are important to them
Strategic advantage	Creates fewer barriers to entry for new competitors to enter and possess globalization features for readily available supply chain

3.1 Business Intelligence Requirements Analysis

Requirement analysis for BI has not been given much attention so far, and it is often overlooked in mainly since (1) the projects are long-term and (2) requirements are poorly shared across organizations [2]. Several surveys indicate that a significant percentage of BI projects fail to meet business objectives or are outright failures. One of the reasons

for this is that requirement analysis is typically overlooked in real projects. The approaches to BI are usually classified in two categories [8]. *Data-driven* approaches design the DW starting from a detailed analysis of the data sources; user requirements impact on design by allowing the designer to select which chunks of data are relevant for decision making and by determining their structuring according to the multidimensional model. *Requirement-driven* approaches start from determining the information requirements of end users, and how to map these requirements onto the available data sources. Some developers use some kind of mixture of these two approaches, and consider both data and user requirements at the same time.

4. Study methods

The study employs a goal-oriented approach and adopts a 3-phase Requirements Management Control (RMC) methodology [3] as shown in Figure 1. Each phase provides the abstraction level of the BI in depth.

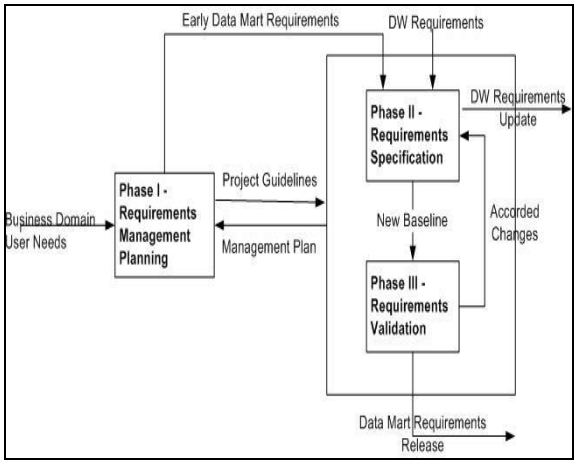

Figure 1: Requirement Management Control (RMC) Framework [3]

The respondents are 25 healthcare professionals including doctors, nurses as well as administration staff in 10 rural healthcare centers in Northern Malaysia.

The RMC method assessed all these phases, which acts as quality assurance of BI requirements as follows:

- Phase I provide general guidelines for requirement elicitation and determining the granularity of the data. This is done by interviews with the respondents and the existing documentation in these centers are also explored and examined.
- Phase II aims to achieve requirement specifications and the procedure involves a cyclic task of acquisition, representation and evaluation of requirements.
- Phase III, the validation process is done by getting feedbacks from the participants. The purpose is to confirm the requirements defined previously as some misunderstandings or misconceptions regarding the BI features might remain unclear. Series of review meetings which involved all the relevant parties are conducted to review BI final release. The BI release is later described in terms of the multi-dimensional BI model [5],[8].

5. Results

5.1 Phase of BI Requirement Definition and Analysis

Phases of BI requirements for BI Malaysian rural healthcare is elicited and analyzed by interviewing respondents which give in-depth insight of the real situation at rural healthcare centers and better understanding of its functions. BI requirements found in this study are summarized in Table 2.

Table 2: Summary of BI Requirement for Malaysian Rural Healthcare

Requirement	Descriptions	Priority
Drugs used	Which of the drug consume most by the rural healthcare patient?	1
Drugs expiry date	Which of the drug is expiring in the next three months in the rural healthcare centres?	1
Patients	Which set of patients patronize the rural healthcare centres the most?	1
Departments	What is the department of the most patronized by the patients in rural healthcare centre?	2
Ethnicity	What is the race of the most patronized patient in rural healthcare centres?	3
District	What is the district of the most patronized patient in rural healthcare centres?	3
Disease	How many patients have skin disease in a period of time?	1
Common disease	Which of the diseases is most common among the patients in rural healthcare centres?	2

(Legend: 1-Urgent, 2-Important, 3-Less Important)

5.2 Business Intelligence Star Schema Model

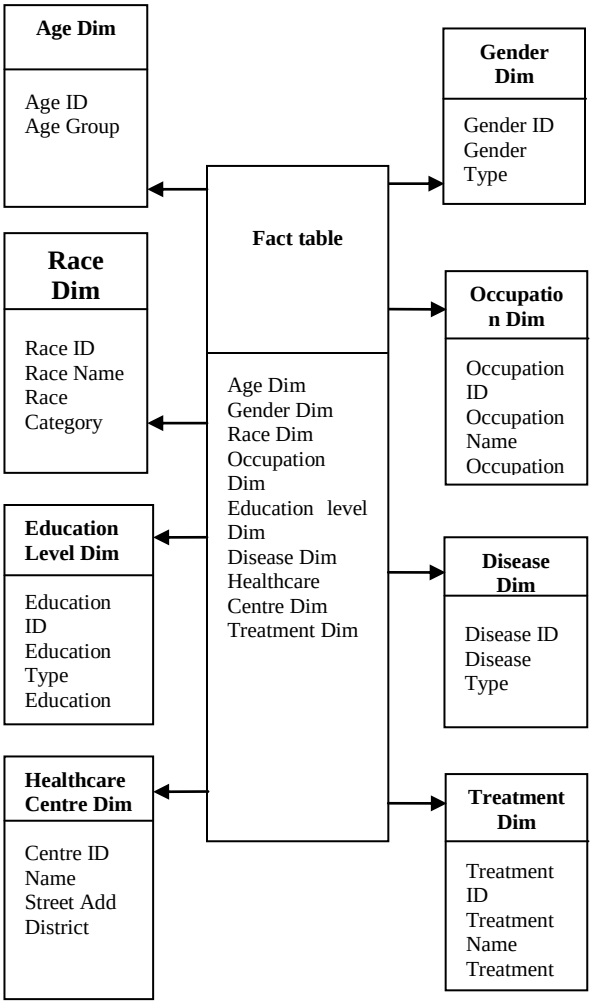

Figure 2. A Star Schema of BI Rural Healthcare

Rural healthcare BI model is developed according to patients and treatment functionalities. Data modelling using star-schema technique is used to present the facts, dimensions and measures for the requirements. A fact record is the nexus between the specific dimension values and the recorded facts. Dimension attributes are organized into affinity groups and stored in a minimal number of dimension tables. Figure 2 illustrate the BI model that includes six dimensions of healthcare centre, age, race, treatment and gender. The model helps management of healthcare centres by simplifying the technique needed for managerial decision making and forecasting future activities. Medical statistics of the rural dwellers and common disease would be useful in future healthcare service delivery for these underserved communities.

6. Conclusion

This study has highlighted the steps that need to consider for achieving requirement model for Malaysian rural healthcare BI. RMC methodology comprising 3-phase of requirements planning, specification and validation is adopted. Star schema is used to model the BI data that supports healthcare reporting. The model is validated by healthcare professional to ensure the requirements are met and would provide guidelines for requirement process in BI development especially in healthcare industry. Some limitations are encountered during the study mainly due to time limit and difficulty in getting healthcare professional commitment for eliciting their requirements. As for future works, it is suggested the model be extended into development of BI systems such as healthcare dashboard that would include the analytics and visualizations of the data into more meaningful information.

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