

Data Warehouse Design for Hospital Executive information using the Facts Constellation Method (Case Study : Bali Mandara Eye Hospital)

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Abstract - In the development of information technology, it is very important for the industry to create a structured data warehouse. It has functions as a track record data and digital archiving. One industry that requires a data warehouse is a hospital. Hospitals need a digitizing system that can store medical record data and other vital data in their managerial system. Hospitals are now required to have a hospital management information system as an information medium to speed up the process of obtaining computerized information. Hospital data warehouse must be built with a systematic, tactical scheme in reporting and can guarantee its confidentiality from unauthorized persons. Displaying reports from the database is possible but has complex and very slow queries. So to make an executive report that quickly requires making dimensional data warehouse. Data warehouse schemes from a good Hospital Management System can be made in various ways, one of which utilizes the Facts Constellation scheme as the research raised by this paper.

Index of Terms - Data Warehouse, Facts Constellation, Hospital Management Information System, Bali Mandara Eye Hospital

I. INTRODUCTION

Data Warehouse has an important role in an industry. In this millennial era, modern companies cannot possibly forget Data Warehouse in their business processes [1]. Data warehouse is a large-scale and highly structured database technology that has the purpose of analyzing static data that has been transformed from various original application sources to resemble business processes, collected over a long period of time and displayed in business terminology and centralized for simplify analysis. This data warehouse will store company data so that it can be processed for the needs of the company's business processes [2]. One of the industries that is very important and requires a data warehouse is a hospital. Hospitals that have implemented a computer base in their daily lives must be storing a lot of data and will grow all the time. In addition, the hospital also has many elements and complex fields and requires a lot of space for digital storage for reporting. At present all hospitals are required to use a hospital management information system for Bali Mandara Eye Hospital to manage hospital administration [3]. The database usually uses a normalized or relational database structure. Displaying reports from the database is possible but has complex and very slow queries. So to make an executive report that quickly requires making dimensional warehouse data warehouse [4].

Therefore, the design of a new data warehouse requires the maturation of the concepts needed to engineer the needs of this hospital. The right scheme can be a trigger for success in a data warehouse design. For this reason, in this research, the stages of compiling a new data warehouse will be elaborated by testing the fact constellation scheme [5]. This scheme was chosen because in theory this process is able to speed up the query process and is suitable as a form of hospital executive report. Fact constellation schema is the most complex scheme compared to star and snowflakes schema, where there are several fact tables and dimension tables can be related to more than one fact table [6]. Therefore this study tries to take advantage of the advantages of this fact constellation scheme to implement it in the hospital database.

II. STUDY LITERATURE

A. Data Warehouse

Etymologically, Data Warehouse theory can be described as a combination of technology and conceptual arrangement that can provide facilitation to organizations to maintain and organize data logs or historical data obtained from a centralized system and operational applications [7]. Every organization will need Data Warehouse because in the modern era, everything is digital.

Data Warehouse provides integration of various types of data from various applications or systems. This concept guarantees a mechanism that is one-door access for management to obtain valid information which can then be analyzed and used as a reference for making important decisions within a company [8].

B. OLAP

OLAP or which means Online Analytical Processin in scientific terms can be explained as a method of approach to present answers to requests for dimensional analysis processes quickly, including the design of applications and technologies that can store, collect, manipulate a multidimensional data that has targets for an analyst goal [9]. A database created for OLAP services in a multidimensional data model, can be used for complex analysis with an execution time rate. This borrows aspects of database navigation and database hierarchy much faster than those of the same type [10]. OLAP is part of a more global category of business thought, which also summarizes the relationship between reporting and data mining. OLAP is usually made in the form of special applications for business reporting, sales, budgeting, forecasting, marketing, reporting management, business process management, financial reports and the like. The term OLAP is the efficiency of the OLTP (Online Transaction Processing) database.

C. Data Warehouse Modeling Techniques

Data warehouse and OLAP are also built from multidimensional data models. In this model, fact tables and dimension tables are needed. The fact table contains numerical facts that have the characteristics of being thin, and are large, long, and often change and are useful for measuring. Whereas the dimension table contains columns which are descriptive, small, short, and wide which are useful for filtering and are based on dimension attributes. The dimensional modeling discussed in this journal is devoted to Fact Constellations (Galaxy Schema), although in modeling the dimensions of a data warehouse there are other modeling schemes, that called Star Schema and Snowflake Schema [11].

D. Facts Constellation

Fact Constellation Schema is a schema in a Data Warehouse that contains more than one table with facts that share dimension tables [12]. The following is a description of this scheme which can be seen in Fig. 1

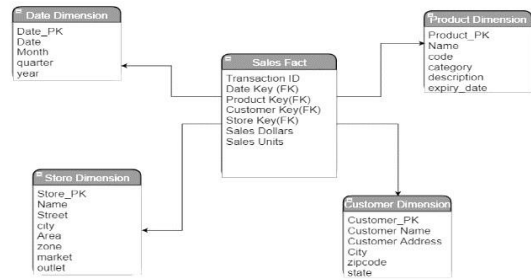


Fig 1. Facts Constellation Schema Examples

Several fact tables that use one or several dimension tables together are included in this scheme. This results if it is designed to look like rows of stars in the sky [13]. Therefore this scheme is also called the galaxy schema due to its shape[14].

III. METHODOLOGY

The following are some of the steps contained in this study, including:

1. Data from the Source

This research using data from a hospital industry, Bali Mandara Eye Hospital that places in Denpasar, Bali.

2. Literature Review

In addition to conducting observations, this research also originates from literature studies, namely journals, scientific works and literature reviews related to this research material.

3. Implementation of the Facts Constellation Scheme

In this process, Kimball's 9 step methodology is carried out. Beginning with the collection of executive information needed, Data Warehouse modeling processes, making OLTP Data Warehouse schemes, designing OLAP Data Warehouse schemes, and finally the Mapping from OLTP to OLAP [15].

4. Implementation Results

The results of this research are in the form of a data warehouse that has been designed using the fact constellation scheme.

5. Conclusions and Future Works

After obtaining the results of the implementation of this study, it is concluded that the facts obtained along with future work plans from the continuation of this research.

IV. ANALYSIS AND RESULT

A. Collection of Executive Information

At the beginning of this stage, some executive information was collected including the number of outpatient visits each month, the number of inpatient visits every month, the number of emergency room visits per month, the number of patient visits based on how to pay, the top 10 outpatient diseases every month, the top 10 inpatient diseases Every Month, Total VIP Revenue every month, Regular Revenue Amount every month.

B. Data Warehouse Model

To build a data warehouse using the fact constellation schema model which has 3 fact tables namely visit fact tables, diagnostic fact tables and income fact tables.

fakta_kunjungan	fakta_diagnosa	fakta_pendapatan
kode_registrasi	kode_registrasi	kode_registrasi
id_layanan	kode_icdx	id_jenis_pembayaran
id_dokter	no_mr	pendapatan_obat
id_jenis_kelamin	id_jenis_kelamin	pendapatan_jasa
id_jenis_pembayaran	tgl_mrs	tgl_mrs
no_mr	id_poliklinik	no_mr
tgl_mrs		id_poliklinik

Fig 2. Data Warehouse Model

C. Facts Constellation Schema

Fact constellation schema is a dimensional model in which there is more than one fact table that divides one or more dimension tables [16]. This scheme is more complex than star schemes because it contains various fact tables. In fact constellation schema, one dimension table can be used in several fact tables so that the design is more complex. The advantage of fact constellation schema is the ability to model business more accurately using several fact tables. But the disadvantage is that it is difficult in complex management and design [17].

In this scheme, several fact tables are linked to the same dimension table, seen as a collection of star schemes, so called the galaxy or fact constellation scheme. Based on this research, the fact constellation scheme will be described in the next step [18].

D. Application Overview

The initial stage of the system starts from entering data from the source database to the application. Data from the source database is carried out by the ETL process in the application so that it produces the Data Warehouse and is entered into the data warehouse database. The user can enter the selection data such as year and month into the application, then the application selects data from the Data Warehouse

Warehouse then provides the Output Data Selection results to the system and is accepted by the User [19].

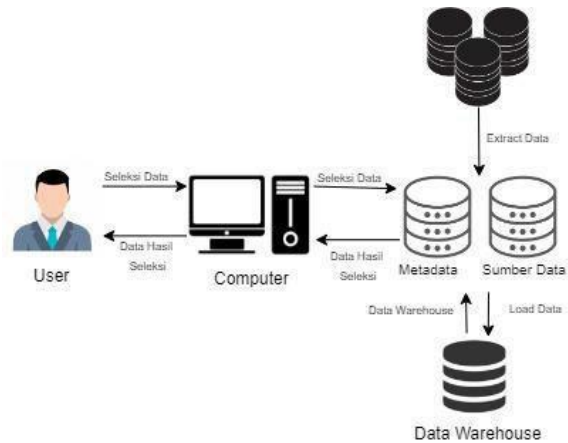


Fig. 3 Application Overview

E. OLTP Database Schema

The next phase is to analyze the data sources needed by this research and then design an OLTP (Online Transaction Processing) scheme. This OLTP scheme will be a source that comes from hospital data [20].

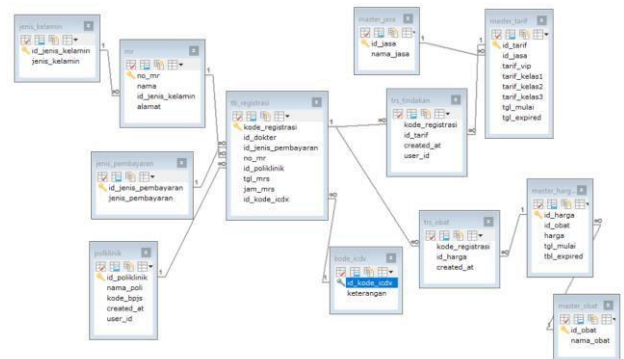


Fig. 4 OLTP Database Schema

In this scheme 12 tables have been made consisting of table jenis_kelamin, table mr, table jenis_pembayaran, table poliklinik, table tb_registrasi, table kode_icdx, table master_jasa, table trs_obat, table master_tarif, table master_harga and table master_obat.. Each has a primary key id as well as a foreign key where these tables will be reconstructed in the OLAP scheme in the following discussion.

F. OLAP Data Warehouse Schema

In this phase the elaboration is where the scheme consists of several fact tables that use one or more dimensional tables simultaneously so that if described they will look like a set of stars. Like the galaxy, therefore it is also called the galaxy schema [21].

V.CONCLUSION

From the analysis of this research, conclusions can be drawn that can be used as a guide for further research. Some of these conclusions are the Fact constellation schema is the most complex scheme compared to the star and snowflakes schema, where there are several fact tables and the dimension table can be related to more than one fact table. Therefore this scheme is needed in the development of data warehouse at the Bali Mandara Eye Hospital. Bali Mandara Eye Hospital is in dire need of Data Warehouse because digital data storage has been initiated and every day the development of data is always growing. Facts Constellation schema is able to speed up the query process and is suitable as a form of hospital executive reporting. It is expected that in the future with this research, future research can make this research as a reference, especially regarding the application of the fact constellation scheme in hospital data warehouses. So, if it can be used as a comparison to measure the success of a data warehouse from various aspects.

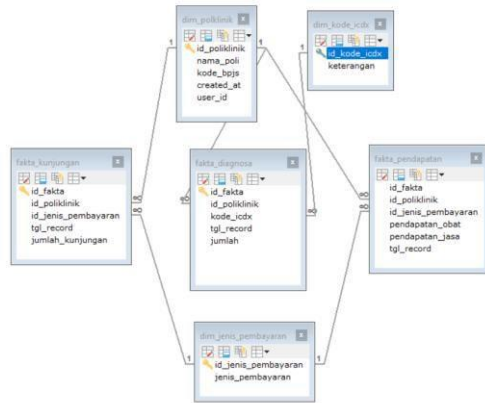


Fig. 5 OLAP Data Warehouse Schema

Data warehouse and OLAP are built based on multidimensional data models. In this model, fact tables and dimension tables are needed. Fig. 5 illustrates the OLAP scheme that has been reconstructed based on the OLTP scheme described earlier. In this scheme the table changes to 6. The table consists of table fakta_kunjungan, table dim_poliklinik, table fakta_diagnosa, table dim_kode_icdx, table fakta_pendapatan and table dim_jenis pembayaran. The results of this reconstruction illustrate several dimensional tables related to fact tables such as the general definition of the fact constellation scheme.

G. Mapping OLTP to OLAP

From the results of the reconstruction described earlier from OLTP to OLAP, it can be elaborated in the form of mapping as shown below.

Database OLTP	Database OLAP
poliklinik	dim_poliklinik
kode_icdx	dim_kode_icdx
jenis_pembayaran	dim_jenis_pembayaran
tb_registrasi	fakta_kunjungan
	fakta_diagnosa
trs_tindakan	fakta_pendapatan
trs_obat	

Fig. 6 Mapping OLTP to OLAP

The explanation is table poliklinik in OLTP reconstructed into table dim_poliklinik in database OLAP, table kode_icdx in OLTP reconstructed into table dim_kode_icdx in database OLAP, table jenis pembayaran in OLTP reconstructed into table dim_jenis_pembayaran in database OLAP, table registrasi in OLTP reconstructed into table fakta_kunjungan and fakta_diagnosa in database OLAP, table trs_tindakan and trs_obat in OLTP reconstructed into table fakta_pendapatan in database OLAP.

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