

Decision Support System Using Data Warehouse for Hotel Reservation System

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Abstract—As a big hotel which has many branches in Indonesia, a hotel should need the express report for business development in order to take decision. This paper proposes data warehouse for supporting business in XYZ hotel to get better information about customers data of each branches for taking decision. The data warehouse development consists nine step methodology designed by Kimball and Ross. Furthermore, the data is able to be presented in dashboard or report corresponding to the user to simplify the data presentation. The data warehouse is used to integrate the data sources needed to provide quick and accurate information.

Keywords—Data Warehouse, Booking system, Decision Support System, Hotel

I. INTRODUCTION

Currently, XYZ hotel many branches in Indonesia. Each branch will provide a summary for their transaction in the end of the month to the central office using a web base as the transactional database. The results of these transactions only become a collection of data that have not been meaningful, and cannot be used as a supporting management in decision-making for business purpose. The results of the transactional database is just a spreadsheet file. It takes a long time to process summarizing report from various spreadsheet files.

The problem above can be solved by building data warehouse system. Many various problem can be also solved by data warehouse [1]. Data warehouse is a database which stores collection of past (historical) as well as present (current) data. Data inside should come from different sources called data marts. Each of these sources has its own designer which creates its database file (collection of data) in different format. Integration of all files in a data warehouse transforms many sources into one format in a consistent database. The challenge therefore is to collect and store data from multiple sources (i.e. data marts) into one coherent structure (i.e. data warehouse) by using ETL (Extract, Transform & Load) process [2].

Data warehouse has been used to solve data processing problems related to various sectors. Tamer uses data warehouse utilizing techniques to manage tourist data in Egypt [3]. He used data warehouse to create prototypes as a base for decision-making issues related to travel visits to Egypt. The data warehouse is used to integrate the data sources for providing fast and accurate information. Joseph George [4] used data warehouses to identify and create optimal designs related to the healthcare domain. Vinai Bhutani [5] combined data warehouse and ERP. Integration has done from various sources, and raises issues related to ERP data warehouse. Aarti Singh [6] implemented the concept of data warehouse on e-governance to create good governance. He developed a data warehouse structure to build accurate and centralized data

which produced good information to support government in making decision.

II. THEORITICAL BACKGORUND

A. Data Warehouse Architecture

Data warehouse is a relational database designed for query process that aims to facilitate the process of analysis and reporting [7]. Data warehouses help organizations to analyze trends based on organizational repository data over a period of time. The main function of the data warehouse is to facilitate organizations in performing strategic planning based on long-term data stored and make good and quick decisions. It makes the “self-service” can be achieved since users can seem to be able to interact with IT department. As a result, it eases the user to retrieve the information needs [8].

To implement the data warehouse, the modelling dimension is used [9]. It is different with the system which does not use the dimension modeling like transactional process. Entity relation diagram (ERD) is mostly used to draw the online transactional process (OLTP).

B. Modelling Dimension

The dimensional model is usually implemented using the star schema [10]. The model that describes the dimension table with the fact table where the fact table is located in centre and connected to all the dimension table that surrounds it. Dimension table consists of qualitative data that contains a big number of attributes. The qualitative data support many analysis process, beside that fact table contains very important attribute which consist of two types of attribute that is foreign keys that refer to dimension table, and attribute measure that can be aggregate according to analysis requirement [7,11].

OLAP is a functional analysis technique such as sumarization, consolidation, and aggregation, and is able to view information from different viewpoints. The OLAP system allows users to query with large load queries and automatically aggregate data from the data warehouse. OLAP focuses on specially oriented analytical queries to analyze data to support decision making.

III. METHODOLOGY

A. Preparing Data Source

The source data comes from a recap of the transaction data of each branch of the hotel, which is submitted in the form of a spreadsheet, the data is then collected and converted into the normalized database form as initial data prior to the ETL process. Form normalization database can be seen in Fig. 1.

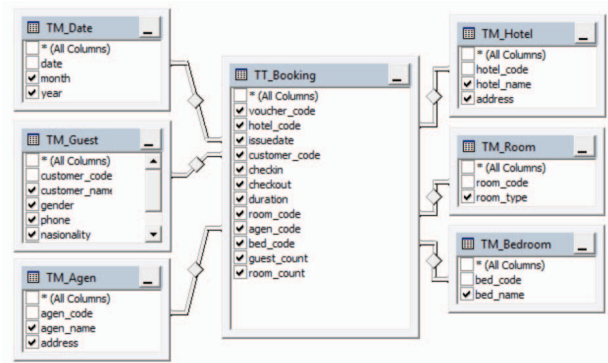


Figure 1 Normalization Database

B. Design of Data Warehouse

Design data warehouse using Kimball method consists nine step [12,13] : choosing the proses, choosing the Grain, Identifying and conforming the dimension, choosing the fact, storing pre-calculation in fact table, rounding table, the duration of the election, slowly changing dimension, the determination of the priority of the query model [14].

Choosing the Process. This stage determines the business process that will be made into the data warehouse. This research focuses on hotel booking transaction.

Choosing the Grain, this stage determines the granularity or relationship of each line of transaction data on the table fact, so that it can be categorized by dimension.

Identifying and conforming the dimension, this stage determines what dimensions can be used to create a table fact according to the relationship of each row of data. Dimensional table of hotel booking transactions can be determined are: hotel dimensions, room dimensions, dimensions of the bed, dimension agent, dimension guest.

Choosing the fact, determining table facts from normal databases derived from data sources, at this stage can already be specified every candidate dimension table and fact candidates, as Fig.2.

Storing Pre-calculation in the fact table, after the table fact is formed, the next step determines the function of each field that serves as a measurement field.

Rounding out the dimension table, identify the dimension table to represent the attribute hierarchy to ease the analysis

Choosing the duration of the database, The duration of data in this step has to be stated. The data duration specified XYZ company for three years, this is done to maintain the dynamics of data warehouse analysis performed. The data warehouse created has a duration of three years from 2015 to 2017. Data obtained in the form of spreadsheet is then converted into OLTP databases. The data on OLTP database is extracted and transformed through the ETL process and moved to the data warehouse.

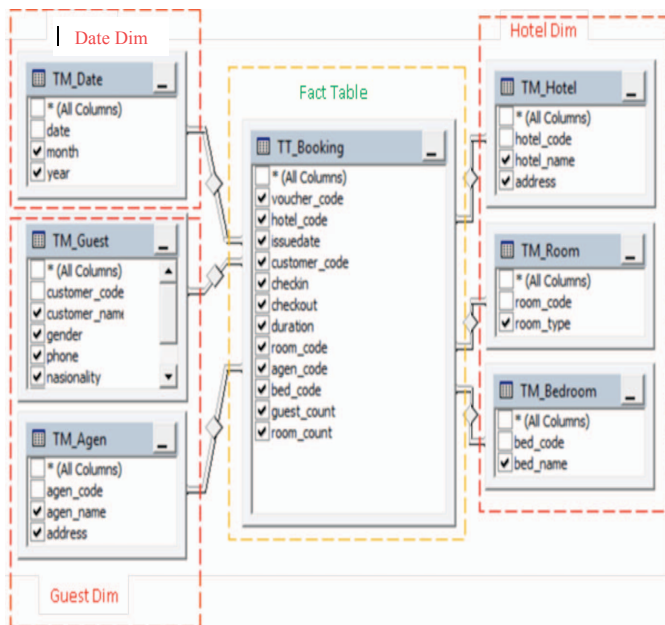


Figure 2 Dimension and fact table candidate

Slowly changing dimension, it is data that changes not affected transaction time, such as guest address, guest region, status [5].

C. Star Schema Model

This model describes the dimensional data structure of the model, where there is a central table as a table fact and several table dimensions are interconnected to the table fact [15]. Pictures of the star schema of the hotel booking process can be seen on Fig.3. This figure shows that star schema consists of 6 dimension table and 1 fact table : agent dimension, guest dimension, hotel dimension, dimension room, bed dimension, date dimension, and fact booking table.

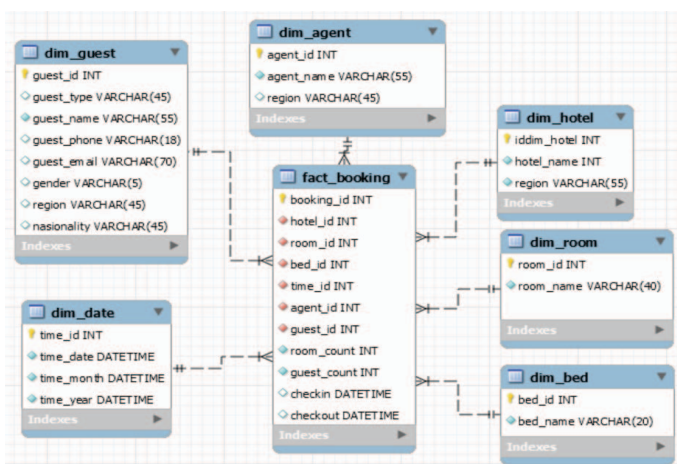


Figure 3 Star schema

D. Surrogate Keys

Surrogate keys are nothing but integers which do not have any meaning in terms of business and used as primary key in dimension table. These are generally smaller integer's numbers which make index size smaller when used as index column.

Where multiple source system loads data into a single dimension, we have to maintain a single SK to enforce the uniqueness of SK. If duplicate record comes from different source, there is a potential risk of duplicates being loaded into the target since the unique constraint is defined on SK not on natural key [5].

E. Extract Transform Load

One of the important step in building data warehouse is building "Extract, Transform and Load (ETL)" process. This process is used to integrate some sources data. The sources data can be take from online transactional process (OLTP) or the manual data [16]. The ETL Process of hotel booking process can be shown on Fig. 4 - 7.

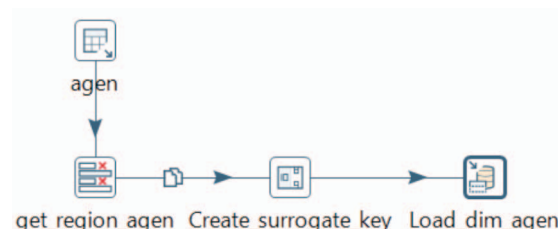


Figure 4 Load Dimension Agent Process

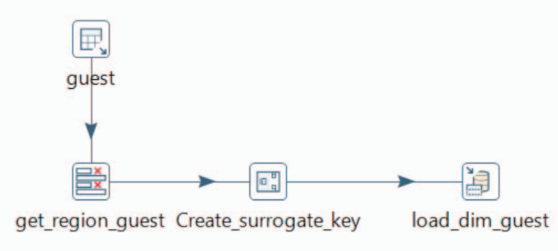


Figure 5 Load Guest Dimension Process

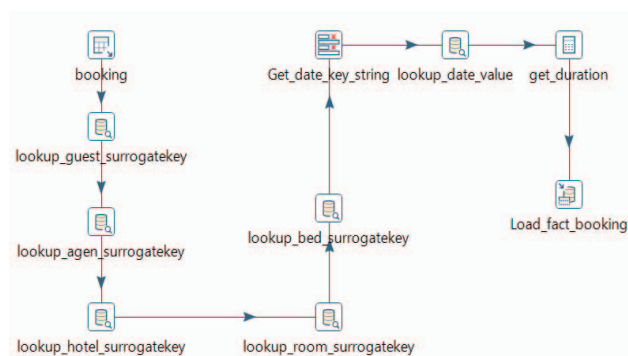


Figure 6 Load Fact Booking

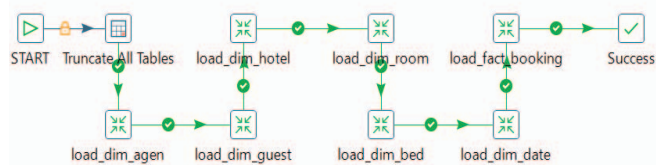


Figure 7 ETL Job

F. Create Mandrian File

After the ETL process is successfully executed, the next step is to create a cube using the *Pentaho* workbench schema, the result of this process in the form of an *xml* file called *Mandrian* file, the form of the *Mandrian* file can be shown on Fig. 8.

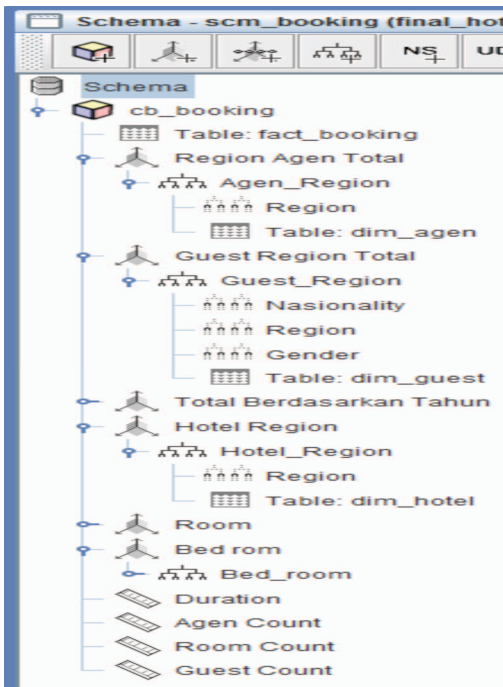


Figure 8 Mandrian File Cube

IV. ANALYSIS RESULTS

By utilizing the power of data warehouse, report generation is now can be processed faster than how it was used to be. Generating reports based on different parameters is also possible. Table I is an example of a table generated to show number of sales by agent region.

Another method to show reports by utilizing charts such as bars, lines, and pies is also available. Fig. explains the number of sales by agent per region using bar chart. Should an overall reports need to be generated, a dashboard is also available to give sum the reports as shown Fig.12. In Fig.10, line chart shows the type of room sales by year.

TABLE I. NUMBER OF SALES BY AGENT REGION

Agen_Region	2015	2016	2017
Balikpapan	60	82	57
Bandung	63	76	56
Denpasar	62	70	50
Jakarta	256	239	137
Lombok	60	65	35
Senayan	63	77	40
Surabaya	52	71	44
Tangerang	185	200	141
Yogyakarta	75	80	44

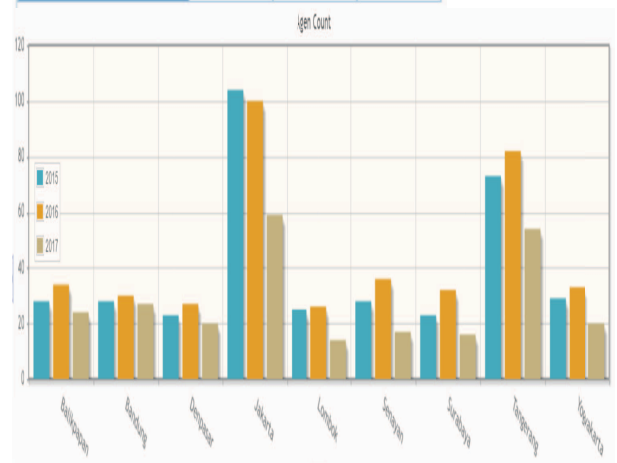


Figure 9 Bar chart number of sales by agent per region

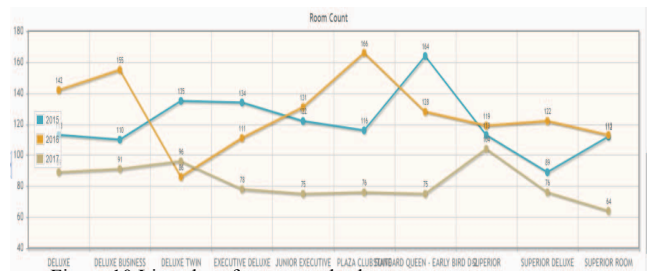


Figure 10 Line chart for room sales by year

Fig.11 shows another version of bar chart to explain guest count per year

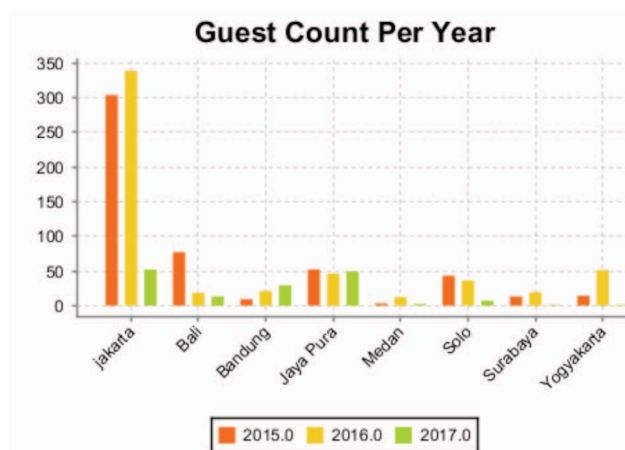


Figure 11 Guest count by year

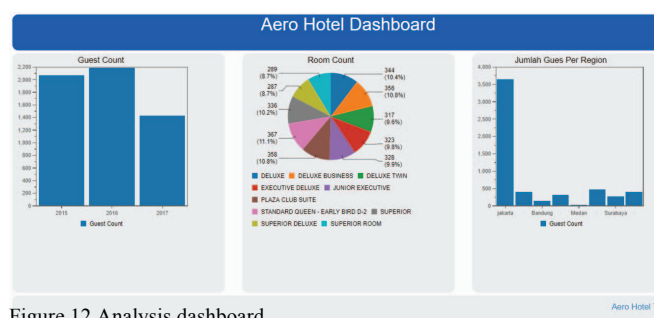


Figure 12 Analysis dashboard

V. CONCLUSION

By development this data warehouse, the report can be made faster which makes easier to take decision. Data warehouse allows report generation in multiple dimensions which is needed in quick decision. Combination reports can be built based on the dimension built such as date, agent, guest, name hotel, room and bed. The many reports given from data warehouse ease taking decisions.

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