Power Distribution Analysis For Electrical Usage In Province Area Using Olap (Online Analytical Processing)

Riza Samsinar[1,*], *Jatmiko* Endro Suseno [2], and *Catur* Edi Widodo [3]

[1] Master Program of Information Systems, School of Postgraduate Studies, Diponegoro University, Semarang - Indonesia
[2] Department of Physics, Faculty of Science & Mathematics, Diponegoro University, Semarang – Indonesia
[3] Department of Physics, Faculty of Science & Mathematics, Diponegoro University, Semarang - Indonesia

Abstract. The distribution network is the closest power grid to the customer Electric service providers such as PT. PLN. The dispatching center of power grid companies is also the data center of the power grid where gathers great amount of operating information. The valuable information contained in these data means a lot for power grid operating management. The technique of data warehousing online analytical processing has been used to manage and analysis the great capacity of data. Specific methods for online analytics information systems resulting from data warehouse processing with OLAP are chart and query reporting. The information in the form of chart reporting consists of the load distribution chart based on the repetition of time, distribution chart on the area, the substation region chart and the electric load usage chart. The results of the OLAP process show the development of electric load distribution, as well as the analysis of information on the load of electric power consumption and become an alternative in presenting information related to peak load.

1 Introduction

Network control center is the center of the grid operating data, a large amount of data that produced from SCADA, EMS, CPS and other systems contains a grid in the operation and safety of all information. However, the current dispatch center information system is mainly for data collection, storage and simple summary of daily operations query, and not specifically for a lot of historical information for effective management and correlation analysis, not effectively use the data from the valuable resource the data extract useful knowledge paired scheduling management [1]. Procedure to calculate total loss in the distribution transformer under non-linear distortion environment is proposed. The power factor capacitor performance under non-linear load conditions is also analyzed. The relation of total current harmonic distortion in the distribution system with load power factor, transformer losses, efficiency and maximum current delivered is also analyzed. The mitigation methods are proposed to minimize the non-linear load impact on the distribution transformer performance. Instead of K-factor transformer approach, a passive harmonic filter method is developed based on higher savings in energy losses [2].

Operational analysis and large data systems for data transmission in electrical power. Data processing techniques use online analytical system to manage and analyze large data capacity. The current center information delivery system is primarily for data collection, data overwriting and simple request

summaries of day-to-day operations, and does not specifically have historical information used for category management and effective correlation analysis. Data collection techniques are large databases that extract previously unknown data information about the operation of the knowledge discovery process, including data warehouses, this processing is done with OLAP analysis, and can be visualized data from the latest information science technology [3]. The data cube generated by the data warehouse is processed using statistical analysis in the process of data mining. One of the methods used to perform the analysis is OLAP (OnLine Analytical Processing). The results of this simplification and summary are presented to users who are the basis of business decision making. Thus management can make decisions based on actual facts and not just rely on intuition and quantitative experience alone [4]. A data warehouse is a "subject-oriented, integrated, time varying, non-volatile collection of data that is used primarily in organizational decision making. Data warehouses provide on-line analytical processing (OLAP) tools for the interactive analysis of multidimensional data of varied granularities, which facilitates effective data mining [5]. The use of systems other than Data warehouses and OLAP as a tool to analyze and collect existing data into information that is very important. This OLAP implementation demonstrates excellence at the level of validation of information, so that the resulting information can be trusted. In addition, with OLAP systems can also analyze data from several experts [6].

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* Corresponding author: riza.upi@student.undip.ac.id

2 Literature review

2.1 Electrical energy

Energy is the ability to perform work, stored energy work. Not much different from physics is as the ability to produce energy. The law of energy preservation states that energy can not be created and can not be destroyed. Energy can only be changed from one form to another. Similarly, electrical energy is the result of changes in mechanical energy (motion) into electrical energy. The existence of electrical energy can be utilized as much as possible. The use of electrical energy in everyday life is lighting, heating, electric motors and others. The energy used by the appliance is the rate of energy use (power) multiplied by the time during which the device is used. When power is measured in clock watts, then

$$w = p * t \dots\dots\dots\dots\dots\dots\dots (1)$$

With:
P = power in watts (W)
T = time in hours (h)
W = energy in watts clock (Wh)
Watt clock (wathour = Wh) is energy released if 1 watt is used for 1 hour.

Provision of electric power to customers, requires a variety of electrical equipment. These various electrical devices connected to each other are interrelated and overall form the power system. As is the power system here is a set of power centers and substations (load center) that are connected by the transmission network so that the unity of interconnection. The need for electricity from customers always increases over time. To keep serving the electricity needs of customers, the power system must be developed in line with the increasing demand of electricity from consumers. To do this as well as possible, the results of operations need to be analyzed and evaluated, among others, to determine.

Distribution system is one of the power system that has an important role because it deals directly with users of electrical energy, especially users of medium and low voltage electrical energy. Usually there is often an unbalanced load on the phase (distribution system is a phase 3 system) or overloaded due to the use of electrical equipment from consumers of electrical energy. A balance between phase loads is required for load equalization to minimize changes caused by full load. This is also important because it is useful in optimization techniques to produce a reliable and efficient system. The 1 phase configuration with 3 wires can be said to be unbalanced if neutral current is not zero. This happens because the connected load, between phases and neutrals are not the same

1.1 OLAP System

OLAP is an integrated decision-making approach for the multidimensional analysis of business data by operations such as Rollup, Drill-down and Pivot. The applications mostly involve business decision support, such as business intelligence, business performance management, financial reporting, knowledge discovery, data mining and other related areas. The advantage of the OLAP system is that it allows end-users to employ a multi-dimensional method for the analysis of ad-hoc data and efficiently provides them with reliable information. Based on these features, OLAP might be useful in other scientific and engineering fields that require multi-dimensional data analyses. It is said that OLAP as a supplement to create a more effective data mining tool for a gene expression database. It integrat the geographic information system and OLAP to facilitate geographic knowledge discovery and to analyze environmental health data. OLAP is employed to analyze the incidence of mealybugs on cotton crops. OLAP is also applicable to environmental problems. The application of OLAP in ecological areas is strongly needed because the data are usually analyzed along multiple dimensions. We therefore consider adopting OLAP for water quality analyses.

A data warehouse (or smaller-scale data mart) is a specially prepared repository of data designed to support decision making. The data comes from operational systems and external sources. To create the data warehouse, data are extracted from source systems, cleaned (e.g., to detect and correct errors), transformed (e.g., put into subject groups or summarized), and loaded into a data store (i.e., placed into a data warehouse). The data in a data warehouse have the following characteristics:

- Subject oriented — The data are logically organized around major subjects of the organization, e.g., around customers, sales, or items produced.
- Integrated — All of the data about the subject are combined and can be analyzed together.
- Time variant — Historical data are maintained in detail form.
- Nonvolatile — The data are read only, not updated or changed by users.

A data warehouse draws data from operational systems, but is physically separate and serves a different purpose. Operational systems have their own databases and are used for transaction processing; a data warehouse has its own database and is used to support decision making. Once the warehouse is created, users (e.g., analysts, managers) access the data in the warehouse using tools that generate SQL (i.e., structured query language) queries or through applications such as a decision support system or an executive information system. "Data warehousing" is a broader term than "data warehouse" and is used to describe the creation, maintenance, use, and continuous refreshing of the data in the warehouse.
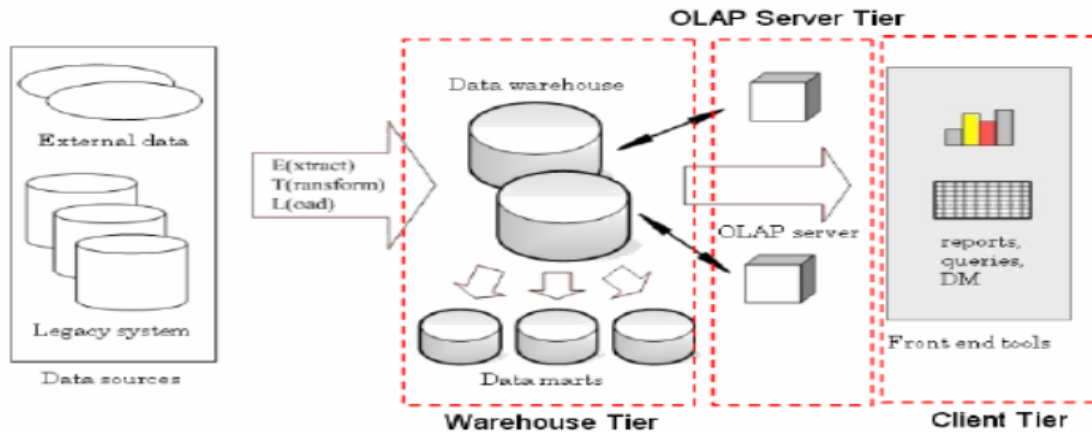
Fig. 1: Data Warehousing Architecture [7]

It includes tools for extracting data from multiple operational databases and external sources; for cleaning, transforming and integrating this data; for loading data into the data warehouse; and for periodically refreshing the warehouse to reflect updates at the sources and to purge data from the warehouse, perhaps onto slower archival storage. In addition to the main warehouse, there may be several departmental data marts. Data in the warehouse and data marts is stored and managed by one or more warehouse servers, which present multidimensional views of data to a variety of front end tools: query tools, report writers, analysis tools, and data mining tools. Finally, there is a repository for storing and managing metadata, and tools for monitoring and administering the warehousing system.

Reporting is public news that contains a collection of information. Business Reporting is public news that contains a collection of business process information and company information, or periodically providing information to decision makers within an organization to support them in their work. Reporting is the result of a process that has an effect on improving companies such as Business Intelligence and knowledge management. Often the implementation involves extract, transform, and load (ETL) in coordination with the data warehouse and then using reporting tools. While reporting can be distributed in print or over the web, they can also be accessed via corporate intranets.

3 Method

At this stage is to collect data related to the total load power distribution of the substation and the transformer special area of DKI Jakarta at PT. PLN (Persero) Distribution Jakarta Raya and Tangerang. The data will be analyzed with OLAP information system with excel data method that has been extracted from internal portal web PT. PLN APD (Persero) Distribution APD Jakarta. PT. PLN (Persero) Distribution Jakarta Raya and Tangerang, especially Jakarta Raya has 16 areas of distribution area, 51 substations and 1906 units of distribution. Incoming data on web portals is not real time, each substation has a shift operator in charge of loading a large repeater load on each substation with an

hourly interval input. Then each distribution area has a load graph of the repeater load and monitor graph of the transformer load on web port APD PT. PLN (Persero) Distribution APD Jakarta

System analysis can be explained in the framework of data warehouse storage. Starting with the processed data phase, ETL, cube on OLAP to create an analytics dimension.
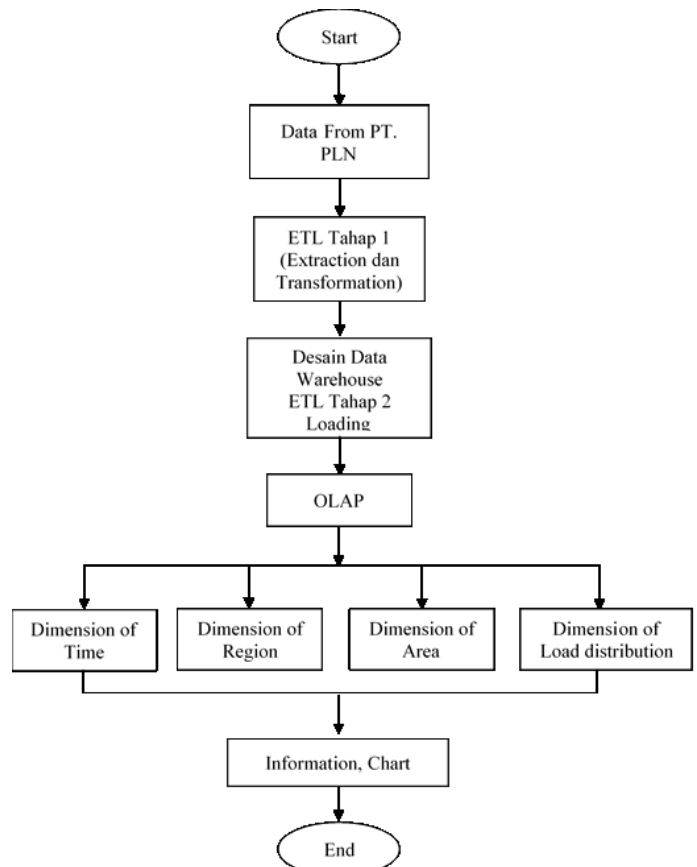

Fig. 2 Research flow

Figure 2 is a framework. that will be used to build a data warehouse for System Analysis Distribution of load power distribution information of PT. PLN (Persero). ETL on loading step is to design a data model that will be used as a data storage that has been transformed, a

model designed with Star Schema Model. Based on data obtained at PT. PLN (Persero), then the Star Schema data model to be built can be seen in Figure 3. In the

process of loading data or data into the data warehouse can use the user interface built with programming language.
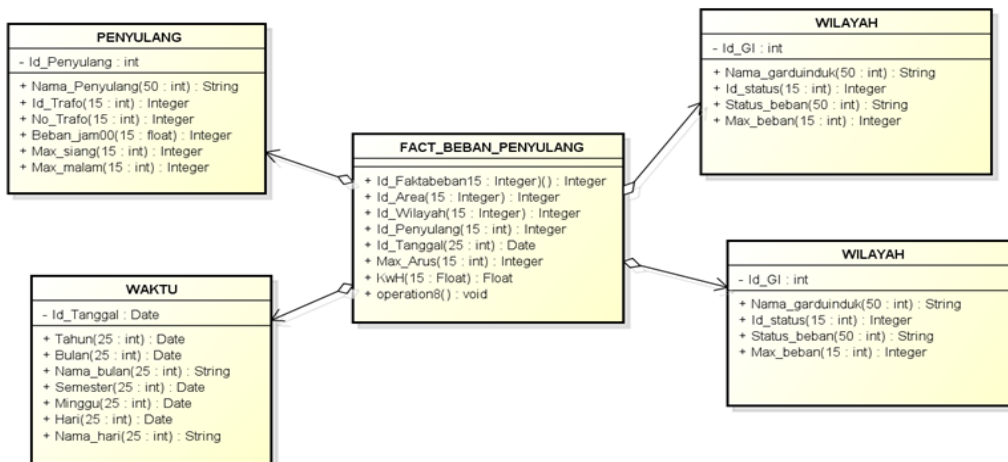
Fig. 3. Star schema model

4 Implementing OLAP system

This section discusses the system design and implementation phases. We begin with the system infrastructure and the database design. Then, we present a system output sample. Olap system with pentaho tools, reporting results with the dimensions of the area. Data that is displayed in accordance with the data warehouse displayed according to the date

Fig.4. area dimensions

The output results that display the analysis of the use of power load based on no transformer on the substation.

View reporting with dimension of area in sorting based on date, area and main transformer as power distribution from substation.

Fig. 5. Area dimensions by area and transformer

Reporting chart area as an example of one of the results of the chart display in other dimensions.
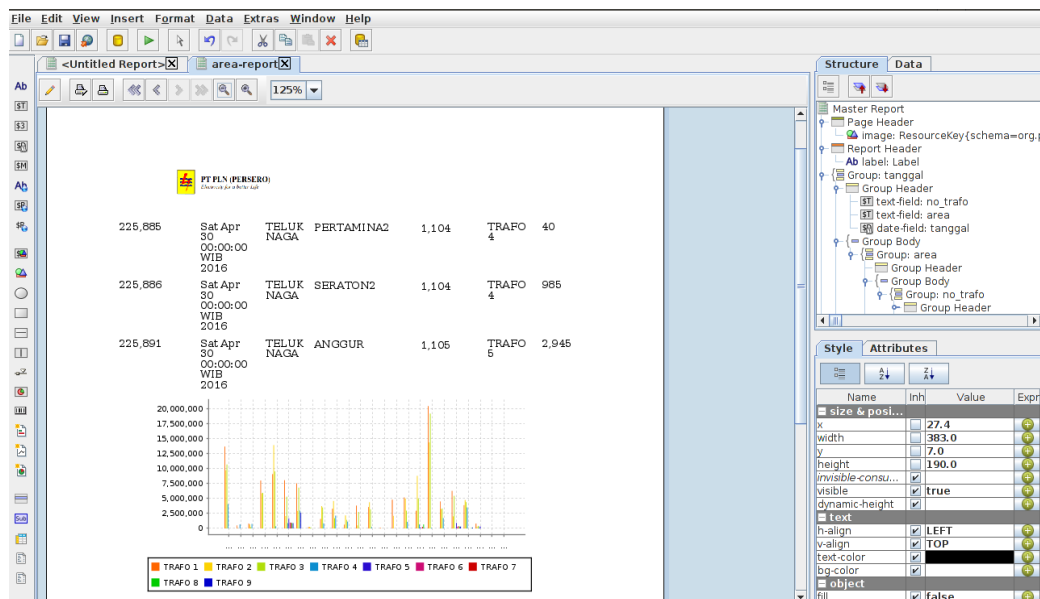
Fig. 6. Data and chart results

5 Conclusion

Information analysis systems can provide information relating to electrical power loads in a single province area. A system that can track information based on multidimensional with area dimension, area dimension, power load dimension and time dimension. The information system built with the olap system with pentaho tools provides load analysis results in the form of charts and queries. The results of its analysis can provide the minimum load, peak load and the amount of load in use on each substation distribution. Lack of information systems that are designed with olap still a little on the dimension side, while olap can be developed more multidimensional dimensions

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