

# ANALYSIS OF DATA WAREHOUSE DESIGN USING POWELL METHOD

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**Abstract** – With the evolution in this digital era, many industrial organizations and companies have begun to move towards digitization to increase the company's business opportunities. Data is something that is very useful in a company's business. If the data processed correctly can provide a variety of information needed by the company to continue to grow. Now Data also becomes digital and data processing have many techniques and can provide us with a decision support for the information generated by the data. The data processing is usually called Data Warehouse. In running a business, business owners must certainly analyze a number of things so that the business continues to run and grow, including one of which is a fabric business in Bali, namely CV Phalani Bali. CV Phalani Bali still needs a centralized system that integrates sales data from online stores and offline stores, therefore a data warehouse is needed that can help manage all these data and make it a new information needed by CV Phalani Bali. So one of the data warehouse design methods is used, is the Powell method. This Powell method focuses on the ETL process to become a data warehouse that is ready to be processed by OLAP. This Powell method will be assisted by Microsoft SQL Server Business Intelligence as a tool that will design and process the sales data into a data warehouse that will produce the information needed by CV Phalani Bali for analyze and make decisions to bring cv phalani bali even more advanced.

**Index of Terms** — Data warehouse, ETL (Extract, Transform, Load), Microsoft SQL Business Intelligence, Powell Method.

## I. INTRODUCTION

In this digital era, many companies have used data as information to move forward. The development of technology has caused many people to obtain data easily [1]. Data if processed properly will present accurate information that can give us a decision support for the information generated by the data. The data processing is usually called Data Warehouse. Research on data warehouses usually focuses on extracting data values owned by companies. With intense competition in the business world and rapid developments in information technology encourage company management to improve their systems so that the decision making process becomes faster and more precise [2]. In running a business, business owners must certainly analyze a number of things so that the business continues to run and grow, including one of which is a fabric business in Bali, namely CV Phalani Bali. CV Phalani Bali offers digital fabric textile printing services on a variety of fabrics. CV Phalani Bali has indeed begun to move towards digitization with the existence of an online shop website that makes it easy for their customers to buy fabric products from CV Phalani Bali and an inventory system, but with that is not enough. Nowadays, a company needs the latest information in decision making. Data warehouse is very necessary to provide the latest information (real time) [3]. CV Phalani Bali still needs a centralized system that integrates sales data from online stores and offline stores, therefore a data warehouse is needed that can help manage and centralize data received from

online stores and offline stores. Data warehouse is a collection of data that is subject-oriented, integrated, time variant, and non-volatile that is used to support evaluation and take decision analysis at the executive level [4].

Some Problems that will appear if the data warehouse is not implemented such as errors in the data, the data not synchronous between the online store and the offline store, and projected data to provide strategic information to support the evaluation and analysis of future decisions will be wrong or incorrect. So the existence of a data warehouse can help the owner of CV Phalani Bali in reporting and historical information of the businesses they run. Data warehouse can help manage historical data and provides strategic information to support evaluation and take decision analysis at the executive level. And can show information about the product data sold, data fabrics that are most in demand, so that it can increase ROI. So one of the data warehouse design methods is used, the Powell method. This Powell method is a method that is almost similar to the 4-step Kimbal method where the steps in making dimensional data start from the end-user, because the end-user is the user of the information from the data warehouse query. The steps in question are started from the determination of business processes, then proceed with granularity after which it identifies and shapes the dimensions and ultimately forms the facts. This Powell method will be assisted by Microsoft SQL Server Business Intelligence as a tool that will design and process the sales data into data warehouse that will produce useful information.

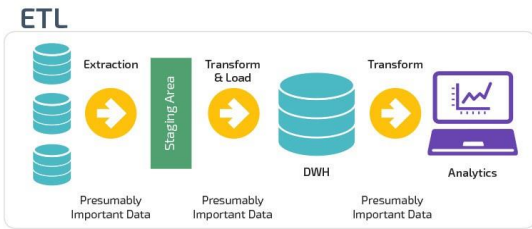
## II. LITERATURE REVIEW

### A. Data Warehouse

Data warehouse is a concept and combination of technology that provides facilities to an organization in the management and processing of historical data obtained from systems and operational applications [5]. Data warehouse is a place to collect all historical data contained in databases that exist in a company [6]. According to McLeod, data warehouse is a large capacity data storage system, where data is collected by adding new records rather than updating existing records with new information. In the data warehouse can accommodate large amounts of data and display it in a multidimensional manner so as to support the process of analysis and make decision making support in several organizations, companies and some government agencies [7]. In the process data warehouse has many methods and processes such as the cimbal, inmon, and powell methods, and there is a process called ETL (Extract, Transform, Load).

### B. ETL

ETL process is a process that exists in the design of data warehouses, as shown in Fig 1.



**Fig 1.** ETL Process

The ETL or Extract, Transform, Load process is a collection of data preparation processes that are initiated by the OLTP (Online Transaction Process) process. The purpose of ETL is to collect, filter, process and combine relevant data from various sources to be stored in a data warehouse [8]. The ETL process is divided into 3 stages: [9]:

- **Extraction**

Extraction is the process of identifying all available and relevant data sources. This process runs through data files or databases, using various criteria in selecting data and finding suitable data, then transporting data to other databases such as database staging.

- **Transformation**

Transformation is a process of manipulating data from a system to another format in a data warehouse or data mart in order to make it an accessible information.

- **Loading**

Loading is a process that moves data that has been transformed into a data warehouse where loading has two loading strategies, the loading strategy for dimension tables and the loading strategy for fact tables.

### C. Powell Method

The Powell method is one of the data warehouse design methods developed by Powell in 2006. In this method Powell said the steps in making a dimensional data model begin with the end-user. Starting from the end-user because end-users are users of information from the results of a data warehouse query [10]. From this understanding, the steps in designing data warehouse according to Powell are as follows:

- Business processes
- Granularity
- Identify and build dimensions
- Build fact

### D. Microsoft SQL Server Business Intelligence

Microsoft SQL Server Business Intelligence is a business intelligence application that can display data visualization, allows making queries, data connections, and reports developed by Microsoft companies [11]. Microsoft SQL Server Business Intelligence is a compact application or full version application created by Microsoft companies to help manage data warehouses. Microsoft SQL Server is an application that has functions to store and retrieve data needed by other applications. In it there is the desired type of service incorporated in the SQL Server management studio including: database engine, analysis engine, report service, and integration service. Microsoft SQL Business intelligence is a process for analyzing data, identifying certain trends and patterns contained in data. Microsoft SQL Server Business Intelligence is needed for [12]:

- Transform complex data  
Create robust data models that can be easily understood and analyzed.
- Modernize reporting  
Provides fully interactive BI reports, and pagination reports from one modern web portal.
- Access BI Report from Mobile  
Access KPI's and reports on any device that uses BI capabilities on a smartphone.
- Enable hybrid BI  
Connecting data to your place from the cloud in real time and accurately.
- Use a proven BI platform  
Take advantage of scalability, access to data that is secured, and tools that are well known.

### E. Star Scheme

Star schema is one of the schemes in designing a data warehouse. According to Connolly and Begg, a star schema is a logical structure that has a fact table consisting of factual data at its center, which is surrounded by a dimension table consisting of reference data (which can be normalized) [13]. The advantage of using a star scheme is that it performs well compared to other schemes. This is caused by the use of a combined level of fact tables with a few dimensional tables, so that it can assist the system in performing aggregation operations [14].

**III. METODOLOGY**

In this research, researchers began the steps in data collection by preparing research using research design, maximizing study literature for a deep understanding of the Powell method in its implementation in the data warehouse design that will be assisted by Microsoft's tools namely Microsoft SQL Server Business Intelligence, besides Study literature The author also conducted 3 data collection techniques used in this research case study. The first technique researchers conducted interviews with the owner of CV Phalani Bali. The second technique is the technique of observation and observation conducted is the type of observation "Participant Observation". Where researchers are directly involved in the design of data warehouses using the Powell method on CV Phalani Bali. In the data warehouse design using the Powell method there are several steps including:

**1. Business processes**

In this stage of the business process is done to determine and describe the subject area of the business from existing functional requirements. The selected subjects were analyzed as a basis for determining the fact table in the next step.

**2. Granularity**

Granularity is the level of detail of needs. The safest choice according to Powell is to include all historical data at the lowest level. The advantage of including lowest level data is to avoid data loss when needed by an executive manager.

**3. Identify and build dimensions**

In this stage, it is done to determine the data needed to support the subject to be formed in several dimension tables. The dimension table will describe the fact table by storing the details of the fact table transaction.

**4. Build fact**

In this stage facts are formed on the basis of a predetermined subject.

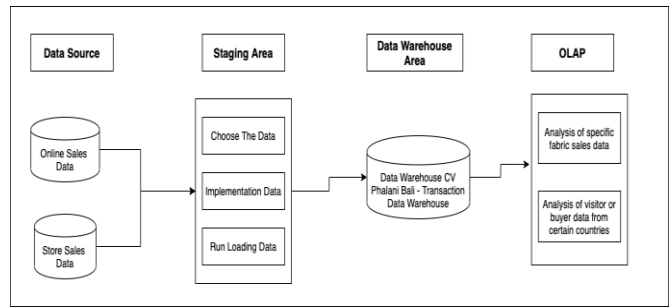
**IV. RESULT AND DISCUSSION**

The CV Phalani Bali data warehouse design process uses the Powell method which emphasizes the ETL process itself, because the ETL process collects, filters, processes and combines relevant data from various sources to be stored in the data warehouse. And the Powell method is more focused on the extraction, transform, and loading processes that have not led to the OLAP process in the data warehouse that produces reporting, as in Fig 2.



**Fig 2. ETL Process Based on Powell Method**

In the data warehouse design from CV Phalani Bali using the Powell method, architectural designs are also formed, as shown in Fig 3.



**Fig 3. Architectural Design**

Data Warehouse CV Phalani Bali

In the datawarehouse design the data source comes from transaction data from the website and transaction data from the store. Where this design will be made up to the Datawarehouse stage. In this design the ETL process is used and the staging area is used in the process. Following are the steps in designing a data warehouse using the Powell method:

**1. Business processes**

In this stage the business area subject matter is determined from the existing functional requirements. Based on the scope and information needed by CV Phalani Bali, a selection process will be used to design the data warehouse. The chosen process is the transaction process from CV Phalani Bali which involves several information needs needed by CV Phalani Bali. Information needs include:

- Displays information on the number of products specified sold in certain stores, in certain months and years..
- Displays information on the number of certain fabrics sold on certain products, at certain times
- Display statistical information on sales according to certain products, in certain months, years and in certain stores.
- Displays information on the number of benefits for a particular product, at a particular store, at a certain time.
- Display information on the number of transactions on certain products, at certain stores, at a certain time.
- Display information on the number of customers who buy certain products, in certain countries, at certain times.

There is from this information need that finally emerged that the business process chosen was the transaction process and transaction data available on CV Phalani Bali.

**2. Granularity**

Granularity is the level of detail needs. In this stage of granularity all the required data is collected in order to support the creation of a data warehouse and also the data collected based on the selected business process. Because according to Powell at this stage all historical data including at the lowest level has its own advantages, such as avoiding data that is lost when needed and avoiding data shortages when needed by analysis material in the future. The data source in this research is:

TABLE I  
DATA SOURCE CV PHALANI BALI

NO	DATA SOURCE
1	Online Sales Data
2	Offline Sales Data (store)
3	Product Data & Fabrics
4	Customer Data
5	Store Location Data

In this stage some data is needed to support the CV Phalani Bali data warehouse design where the data include: online sales data where CV Phalani Bali has a website to sell its products through online based. Then there are offline sales data which in addition to marketing their products online via the website, CV Phalani Bali also sells its products in an offline store consisting of 2 stores. Then the data needed is master data such as product & fabric data, customer data, and store data location. All data is based on the business processes that have been determined in the first step, namely the business process transactions from CV Phalani Bali.

### 3. Identify and Build Dimensions

In this stage, it is done to determine the data needed to support the subject to be formed in several dimension tables. The dimension table will describe the fact table by storing the details of the fact table transaction. In this stage, the information business is identified based on the first stage where at this stage it is identified in more detail and its dimensions are also determined. Some points that become a reference in this identification are: Information needed is based on the information needs that have been determined in the first step, the dimensions used are 3 dimensions so that later when developed into OLAP (Online Analytical Processing) can compare from 3 different parameters or dimensions, measure or the level of measurement used is a reference to the assessment measures for each information that is executed. The following is identification of existing business information that can be seen in Table II.

TABLE II  
BUSINESS INFORMATION IDENTIFICATION

NO	BUSINESS INFORMATION IDENTIFICATION
1	Displays information on the number of certain products sold at certain stores, in certain months and years. <b>Measure:</b> The number of products sold <b>Dimensions:</b> Store, Product, Time
2	Displays information on the number of certain fabrics sold on certain products, at certain times. <b>Measure :</b> Number of fabrics sold <b>Dimensions:</b> Store, Fabrics, Time

3	Displaying statistical information on sales according to certain products, in certain months, years and in certain stores. <b>Measure :</b> Sales statistics <b>Dimensions:</b> Store, Product, Time
4	Displays information on the number of benefits for a particular product, at a particular store, at a certain time. <b>Measure:</b> Amount of profit (Rupiah) <b>Dimensions:</b> Store, Product, Time
5	Displays information on the number of transactions on certain products, at certain stores, at a certain time. <b>Measure:</b> Number of transactions <b>Dimensions:</b> Store, Product, Time
6	Displays information on the number of customers who buy certain products, in certain countries, at certain times. <b>Measure:</b> Number of customers <b>Dimensions:</b> Product, Country, Time

After identifying the business information in detail, an information package is formed which summarizes the details of the identification of the business information. In this information package contains the dimensions of each business information that has been previously identified and contains details of each dimension. Can be seen in Table III about the information package that has been formed at this stage.

TABLE III.  
INFORMATION PACKAGES

DIMENSIONS DETAIL				
Store	Time	Product	Fabrics	Country
Store_Id	Years	Product_Id	Fabrics_Id	Country_Id
Store_Name	Month	Product_Name	Fabrics_Name	Country_Code
Store_Location	Days	Product_Price	Fabrics_Price	Country_Name
Store_Address		Product_Image	Fabrics_Stock	
Store_Contact		Product_Status	Fabrics_Image	
		Product_Desc	Fabrics_Status	

**Business Processes : Sales**

After the formation of the information package has indirectly led to the form of fact and dim to be processed in the next stage. Before proceeding to the next stage, ERD Diagrams are formed to be the data source of the data warehouse to be created. Fig 4 shows the ERD diagram from the Phalani database as a data source.

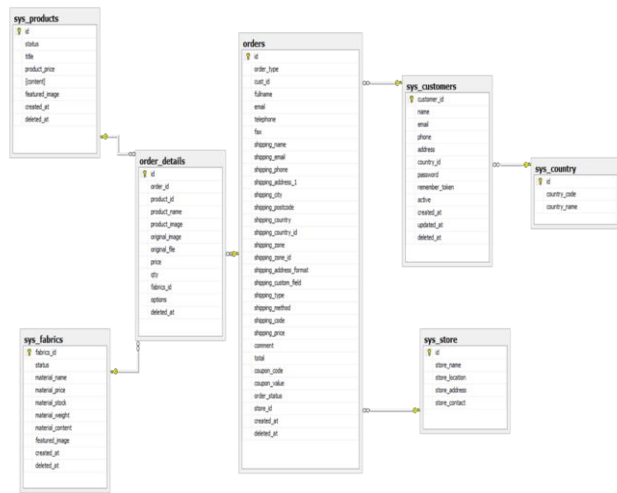


Fig 4. ERD Diagram Phalani Database

In this ERD Diagram there are several interconnected tables including: Sys\_Country which is a table for a list of countries or countries, Sys\_Product is a table for a list of fabric products sold, Sys\_Fabrics Is a table from a list of existing and ready stock fabrics, Sys\_Customers is a table of the list of customers who have shopped at CV Phalani Bali both online and offline stores, Orders & Order\_Details is a table of transaction lists and details of customers who have shopped at CV Phalani Bali both online and offline stores, and Sys\_Store is a table for a list from a store or a store from CV Phalani Bali.

4. Build Fact

In this stage facts and dimensions are formed on the basis of a predetermined subject. At this stage the facts of the previous steps have been formed. This fact is based on the dimensions that exist at the Business Information Identification stage. The following are facts that have been successfully formed, including:

- Number of Products Sold (Items)
- Number of Fabrics Sold (Items)
- Sales Statistics (Percentage)
- Total Benefits (IDR)
- Number of Transactions (Number)
- Number of Customers (People)

After the facts are formed it will be able to produce a scheme. Inside the data warehouse there are 2 schemes, they are star schemes and snowflake schemes.

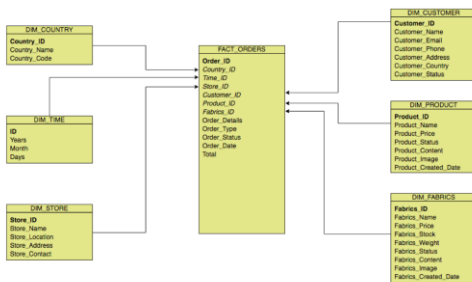


Fig 5. Star Scheme

In the ETL design process in this data warehouse that uses the Powell method the star scheme is used. Star schemes are used because existing tables don't need to be normalized and are suitable for building cube or cube OLAPs if they want to be further developed. Star schemes formed from these facts will be like in Fig 5. In this star scheme has 6 dimensions and 1 fact. An explanation of this star scheme can be seen in Table IV.

TABLE IV  
STAR SCHEME DETAILS

STAR SCHEME	
<b>Country Dimension (Dim_Country)</b>	It is a dimension to analyze country data that often purchases CV Phalani Bali products
<b>Time Dimension (Dim_Time)</b>	It is a dimension to analyze the time based on the year / month / day in which the customer purchases the CV Phalani Bali product.
<b>Store Dimension (Dim_Store)</b>	Is a dimension for analyzing the most visited store by customers
<b>Customer Dimension (Dim_Customers)</b>	It Is a dimension for analyzing the behavior of customers who buy CV Phalani Bali products.
<b>Product Dimension (Dim_Product)</b>	It is a dimension for analyzing products that are often purchased by CV Phalani Bali customers
<b>Fabrics Dimension (Dim_Fabrics)</b>	It is a dimension for analyzing fabrics that are often ordered by CV Phalani Bali customers.
<b>Transaction Fact (Fact_Orders)</b>	It Is a fact that contains data - data that will be analyzed and made a report on the cube in the OLAP process.

In the process of designing a data warehouse using the Powell method on CV Phalani Bali in this research, it is also assisted by Microsoft SQL Server Business Intelligence tools in helping to apply the ETL design steps in the Powell method. Microsoft SQL Business intelligence is a process for analyzing data, identifying certain trends and patterns contained in data. In this research, this tool is useful to assist researchers in building databases for the CV Phalani Bali data warehouse. The data for the phalani database is obtained from the steps in the Powell method which are specific to ETL operations. The data source in this database is a collection of data that has been processed in the granularity step of the existing data sources and the data needed. The first ETL design process assisted by Microsoft SQL Business Intelligence is the process of moving data sources into data staging, which is where the process is in the third stage of the powell method, namely Identification and forming dimensions. Data staging provides a place with a set of functions to clean, change, merge, convert, prevent data duplication, and prepare data sources for storage and use in the data warehouse as shown in Table V.

TABLE V



DATA SOURCE TO DATA STAGING

DATA SOURCE TO DATA STAGING		
Table Name in Staging	Table Name in Source (Transactional)	Operation
COUNTRY	Sys_Country	Transform Minor
STORE	Sys_Store	Transform Minor
PRODUCT	Sys_Product	Transform Minor
FABRICS	Sys_Fabrics	Transform Minor
CUSTOMER	Sys_Customer	Transform Minor
ORDERS	Orders	Transform Minor
ORDER_DETAIL	Order_Detail	Transform Minor

In the process of making data sources into data staging in the process of changing tables in data sources or transactional into tables in data staging using "transform minor" operations which take data from the source system, place it in the staging area, then change and load the data into a data warehouse. This process in the Microsoft SQL Server Business Intelligence tools is illustrated in Fig 6 and Fig 7.

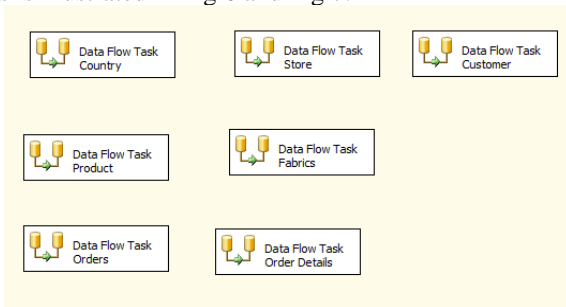


Fig 6. Data Flow Task MS SQL BI

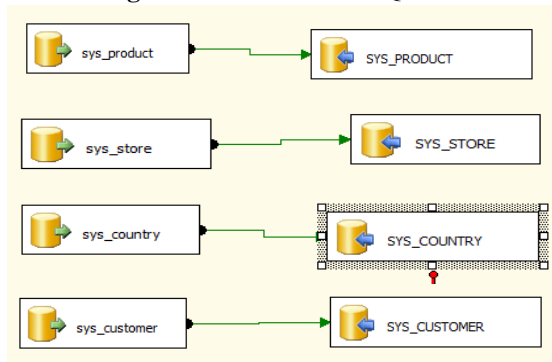


Fig 7. Data Source to Data Staging With Transform Minor Operation

That way the data staging is ready for use because it has been cleared in the process. Then the next design process is the process of moving from clean data staging to a data warehouse so that it is ready to be processed in OLAP, which is where the process is at the 4th stage of the powell method, which is forming the facts (Build fact). Data warehouse is prepared to later be processed by OLAP into a report that can produce information based on information needs that have been determined. Its use as shown in Table VI.

TABLE VI  
DATA STAGING TO DATA WAREHOUSE

DATA STAGING TO DATA WAREHOUSE		
Table Name in Data Warehouse	Table Name in Staging	Operation
DIM_COUNTRY	COUNTRY	Transform Minor
DIM_TIME	-	Generate By Code
DIM_STORE	STORE, COUNTRY	Join, Transform Minor
DIM_PRODUCT	PRODUCT	Transform Minor
DIM_FABRICS	FABRICS	Transform Minor
DIM_CUSTOMER	CUSTOMER, COUNTRY	Join, Transform Minor
FACT_TRANSACTION	PRODUCT, FABRICS, STORE, ORDER, CUSTOMER	Join, Agregasi

In the process of making data staging into a data warehouse in the process of changing tables in data staging into a table in the data warehouse using several operations including operations "transform minor", "join - transform minor", "join - aggregation". This process in Microsoft SQL Server Business Intelligence tools is illustrated in Fig 8, Fig 9, and Fig 10.

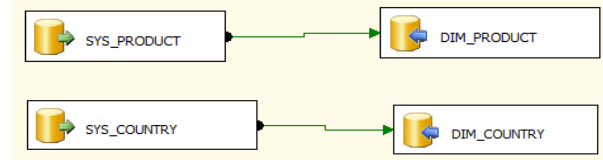


Fig 8. Data Staging to Data Warehouse With Transform Minor Operation

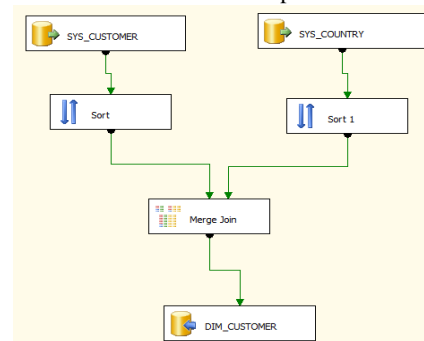
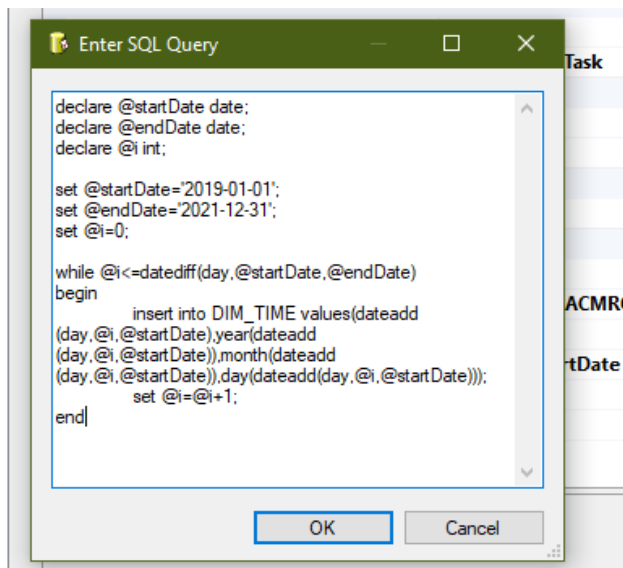
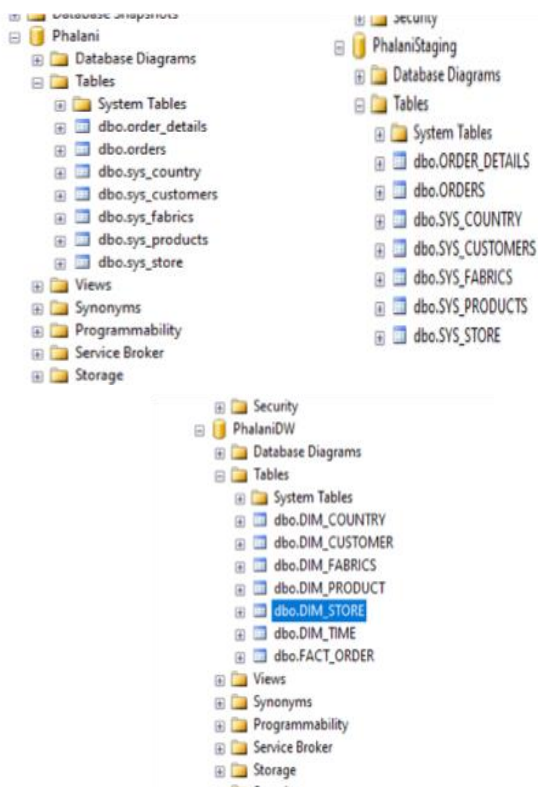


Fig 9. Data Staging to Data Warehouse With Join - Transform Minor Operation



**Fig 10.** Data Staging to Data Warehouse With Generate Code for Time Dimentions

After all the processes are done, it can be seen in SQL Server Management Tools, there will be 3 databases each for data source, data staging, and data warehouse. Can be seen in Fig 11 where DB Phalani is a data source, DB PhalaniStaging is a data staging, and DB PhalaniDW is a data warehouse.



**Fig 11.** Phalani Database, PhalaniStaging, PhalaniDW

## V. CONCLUSION

From the results of the CV Phalani Bali data warehouse design using the Powell method, this method is very concise

for a method in designing a data warehouse compared to other methods because it only needs 4 steps where each step already represents the steps to design a data warehouse. This Powell method focuses on the ETL (Extract, Transform, Load) process to become a data warehouse that is ready to be processed by OLAP (Online Analytical Processing). Analysis of data warehouse can be done multidimensionally. The data warehouse design that was created is related to the transaction process of CV Phalani Bali itself so that it can help manage historical data and provide strategic information to support evaluation and take decision analysis at the executive level. With the Microsoft SQL Server Business Intelligence as a tool that helps in designing the data warehouse database is very helpful and can be directly used for the OLAP process.

For future development, it is recommended to start the OLAP process with Cube and Reporting so that CV Phalani Bali gets real and accurate information to be able to further develop. And further development of further research is carried out by implementing data mining systems so that the analysis process can be carried out in more depth and patterned based on existing approaches in data mining systems.

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