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Sales Analysis on Garment Industry with Datawarehouse Star Schema and ETL Implementation

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Abstract

In the current industrial era, clothing companies face increasingly complex challenges in maintaining the quality and sales of their products. To overcome these obstacles, companies must have a good vision, mission, and decision-making capabilities supported by efficient data management. Data is becoming a valuable asset in Industry 4.0, pivotal in process management, increased productivity, and competitive advantage. This research explores the implementation of Data Warehouse (data warehouse) and ETL (Extraction, Transformation, and Load) processes on star schema for PT Golden Flower Tbk. A data warehouse is a container for storing company data, supporting decision-making, and providing business insights. Meanwhile, the ETL process ensures that the data entered into the warehouse is clean, structured, and ready for analysis. PTA garment manufacturing and exporter company, USPT Golden Flower Tbk, uses the Pentaho application to carry out the ETL process. Pentaho, a Business Intelligence tool, facilitates easy data processing and analysis. This research also explains the use of dimension tables and fact tables in star schemas, which form the basis for more in-depth data analysis. Through visualization and analysis using star schema, Mondrian, and schema workbench, companies can identify sales patterns in each branch and understand which products are most in demand by consumers. The results of the star schema, moMondrianand schema workbench provide a better understanding of the company's sales performance, enabling more informed decision-making and more effective strategies.

A. Introduction

Nowadays, obstacles in industry are increasingly complex due to the significant competition between sectors, especially the garment or clothing industry. It is vital for the clothing industry always to maintain the quality of its clothes and sales. Therefore, a good and correct vision and mission are needed for the industry or company to achieve targets. Apart from that, there is something that is no less important for the industry in making decisions and achieving its targets, namely data. Because data is a valuable asset in Industry 4.0, with significant applications in process management, increasing productivity, and competitive advantage [1][2]. Data can help the clothing industry encourage sustainable practices and innovation [3]. This can be achieved through data to understand consumer behavior and preferences and design new products and processes.

PT Golden Flower Tbk is a well-known company manufacturing and exporting garments in Indonesia. This company is widely known for the excellent quality of its products, ranging from men's clothing, women's clothing, women's blouses, men's shirts, and others. This company was founded in 1980 and is also the complete shopping solution for clothing production, incredibly casual and formal clothing for men and women, with a total production capacity of around 8.5 million pieces per year. As a leading company, it is undoubtedly supported by professional human resources and sophisticated garment technology. PT Golden Flower also has a lot of employees, with a total of around 3500 people, and 8 production facilities are located in bonded zones. With the scale of a company being so large, it certainly has a lot of data that must be processed, so the company must have a system that can support large-scale data processing, namely a data warehouse.

A data warehouse collects subject-oriented, integrated, time-variant, and non-volatile data to support management decision-making [4]. Data warehouses are also significant for storing company data, assisting decision-making, providing business insights, and turning data from supporting activities into assessment assistance capabilities [5]. Implementing a data warehouse into PT Golden Flower can help increase the visibility of sales orders throughout their life cycle, assisting decision-making in various areas of the supply chain [6].

Before the data enters the warehouse, it will be processed by extracting, transforming, and loading. This process is known as the ETL process or extract, transform, and load, which is the process of loading data from source to destination, often carried out at night to ensure high data availability and accuracy [7]. The ETL process also aims to collect data from various sources, process it, and store it in an integrated data store for a data warehousing environment [8]. PT Golden Flower can use ETL through the Pentaho application. This application can make it easier for companies to view and process data stored in the database and make decision-making easier [9].

Pentaho application is the best Business Intelligence tool for Marketing, Transportation, and Financial services, offering the best data processing performance among other tools [10]. This Pentaho application helps analyze and display good or structured data, multidimensional analysis of non-relational data, and data visualization [11]. With Pentaho, companies can gain insight from data

that has been processed or is correct [12]. This research will focused on the implementation of Dataewarehouse and ETL with Pentaho Data Integration (PDI) application for Sales Analysis on PT Golden Flower.

B. Research Method

A dimension table is a matrix with rows and columns used to organize and find the location of data regarding two parameters [13]. Dimension tables also usually only contain when, where, what, etc. Apart from that, the dimension table also explains the entity of a business or the work of an enterprise [14]. In general, dimension tables have descriptive data, which usually rarely changes [14]. Here, there are two dimension tables: a product dimension table or product dimensions and branch or branch dimensions, which will be used in the fact table to solve problems.

The fact table is the central table in the star schema of the data warehouse. These fact tables store quantitative information for analysis and are often denormalized. Fact tables usually work with dimension tables. The fact table holds the data to be analyzed, and the dimension table stores data about how to analyze the data in the fact table. So, a fact table consists of two types of columns. Foreign vital columns allow joining with dimension tables, and measure columns contain the analyzed data. Here, the fact table is needed to solve the problem of searching for the highest sales and products most in demand by consumers at PT Golden Flower Tbk.

Star Schema is a structure in a database that has been optimized and is used for data warehouses with one fact table that stores measurable transactional data and one or more dimension tables that hold data attributes. Star schema is an excellent choice because it is easier to understand with a simpler model; it can make it easier to find content because it is straightforward by looking at it step by step. Having a star schema can also make solving problems more accessible, such as wanting to see orders from each branch of PT Golden Flower.

C. Result and Discussion

The Pentaho application is used to carry out the ETL process on PT Golden Flower Tbk data. First, the extraction process will be carried out, namely extracting/copying data using the input table on Pentaho. Then, proceed with data transformation by sorting the data using sort values and displaying the desired columns using select values.

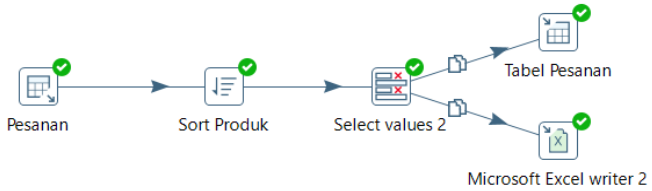


Fig 1. Order Transformation

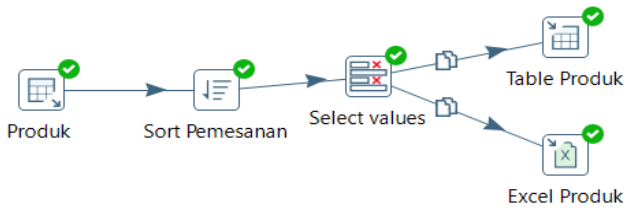


Fig 2. Product Transformation

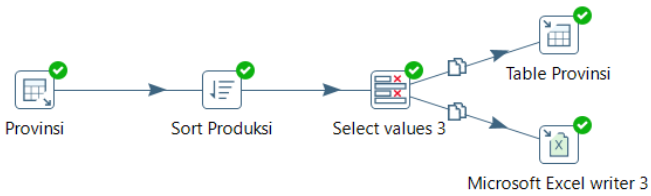


Fig 3. Province Transformation

From Figure 1 above, we can see that in the orders table, the transformation process is carried out by sorting and selecting order data values, loading them into the database, and loading the data into Excel. Then, in Figure 2 above, we can see that in the product table, the transformation process is carried out by sorting and selecting product data values, loading them into the database, and packing the data into Excel. From Figure 3 above, it can be seen that in the province table, the transformation process is carried out by sorting and selecting province data values, loading them into the database, and loading the data into Excel.

Fig 4. Job from all transformation

After these transformations are made, the data will be continued to the job where all the data will be entered into the same Excel to make it easier to see the data that has been ETL. Figure 4 shows the job of all transformations, where the data will be entered into Excel when executed. Furthermore, Figure 5 below is the result of the database loaded from the transformation process, namely the order master database.

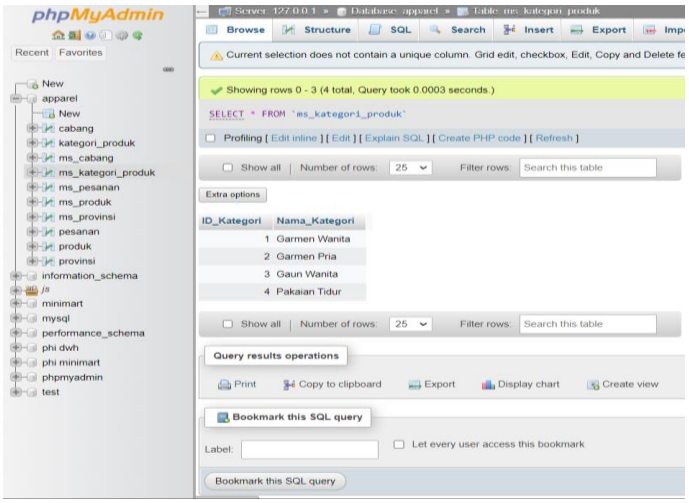


Fig 5. Database from master category product

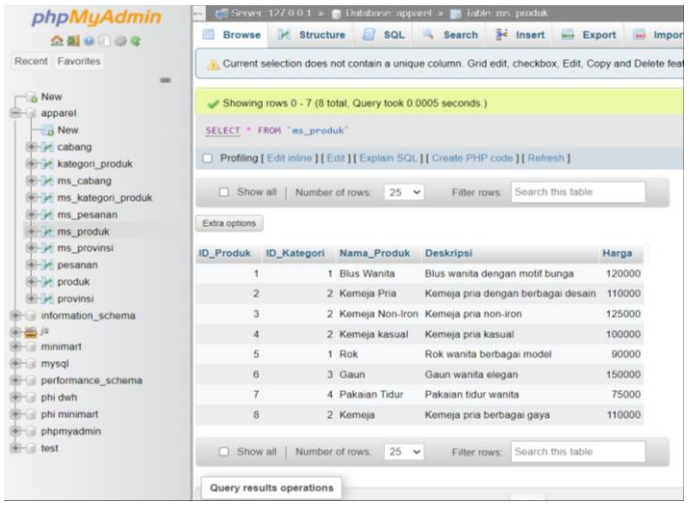


Fig 6. Database from master product

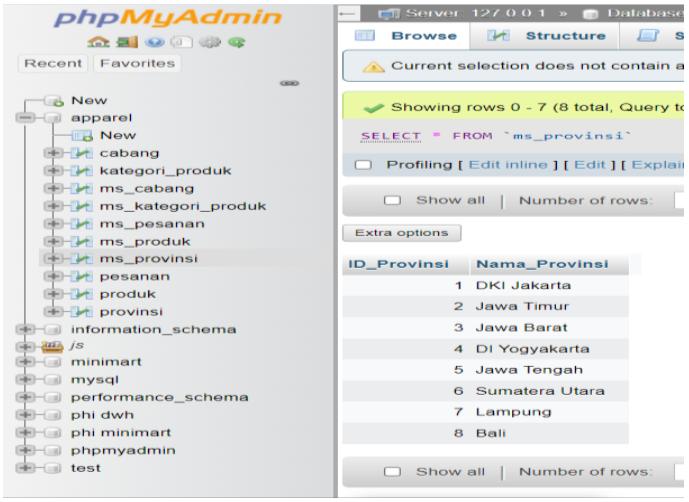
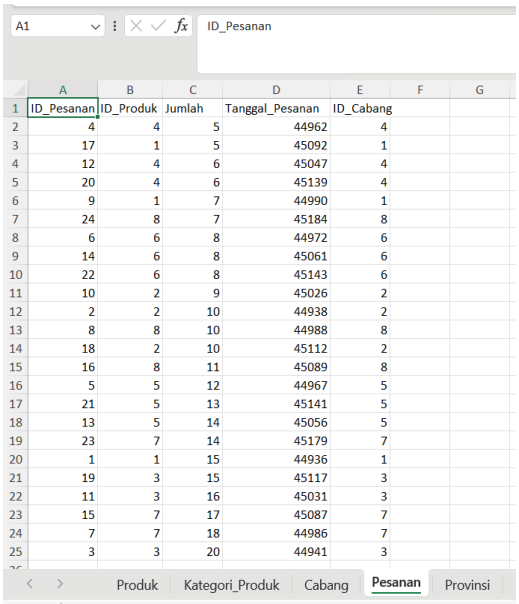


Fig 7. Database from master province

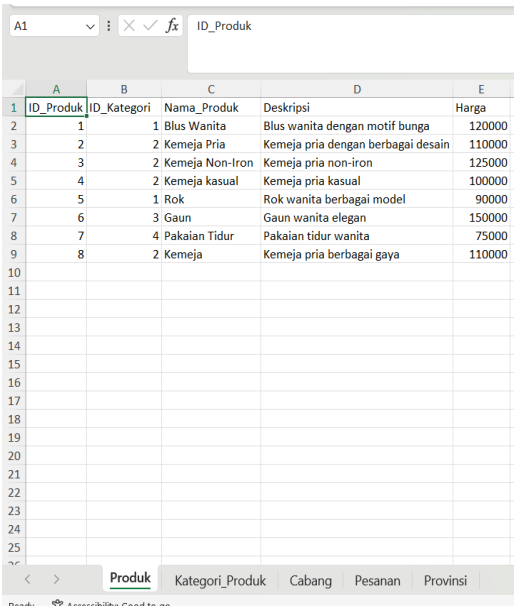
From all the pictures above, a database has been created, where apart from entering Excel, the data is also entered into the database to make it easier for

companies to see the existing data and continue building a star schema. Before joining the star schema, we must create a dimension table containing the attributes of the current data or what is also called a master table. After all the databases shown in Figures 5, 6, and 7 have been successfully loaded, the transformation load will then be generated in the form of a spreadsheet using Excel whose data has been loaded from the transformation that has been created.



ID_Pesanan	ID_Produk	Jumlah	Tanggal_Pesanan	ID_Cabang
4	4	5	44962	4
17	1	5	45092	1
12	4	6	45047	4
20	4	6	45139	4
9	1	7	44990	1
24	8	7	45184	8
6	6	8	44972	6
14	6	8	45061	6
22	6	8	45143	6
10	2	9	45026	2
2	2	10	44938	2
8	8	10	44988	8
18	2	10	45112	2
16	8	11	45089	8
5	5	12	44967	5
21	5	13	45141	5
13	5	14	45056	5
23	7	14	45179	7
1	1	15	44936	1
19	3	15	45117	3
11	3	16	45031	3
15	7	17	45087	7
7	7	18	44986	7
3	3	20	44941	3

Fig 8. Order spreadsheet (output)



ID_Produk	ID_Kategori	Nama_Produk	Deskripsi	Harga
1	1	Blus Wanita	Blus wanita dengan motif bunga	120000
2	2	Kemeja Pria	Kemeja pria dengan berbagai desain	110000
3	2	Kemeja Non-Iron	Kemeja pria non-iron	125000
4	2	Kemeja kasual	Kemeja pria kasual	100000
5	1	Rok	Rok wanita berbagai model	90000
6	3	Gaun	Gaun wanita elegan	150000
7	4	Pakaian Tidur	Pakaian tidur wanita	75000
8	2	Kemeja	Kemeja pria berbagai gaya	110000

Fig 9. Product spreadsheet (output)

Figures 8 and 9 above are Excel orders and products resulting from the data load from the transformation that has been made. Through an Excel spreadsheet that has been entered from all previous master data, there are column values that have been entered into Excel. After the data in the spreadsheet has been successfully loaded, a fact table from the star schema is needed. The star schema requires 2 types of tables: a fact table and a dimensional table or dimension table created from the ETL process. The fact table and dimensional table can display data that has been normalized, which is also appropriate for solving problems in the company and can help the company make decisions.

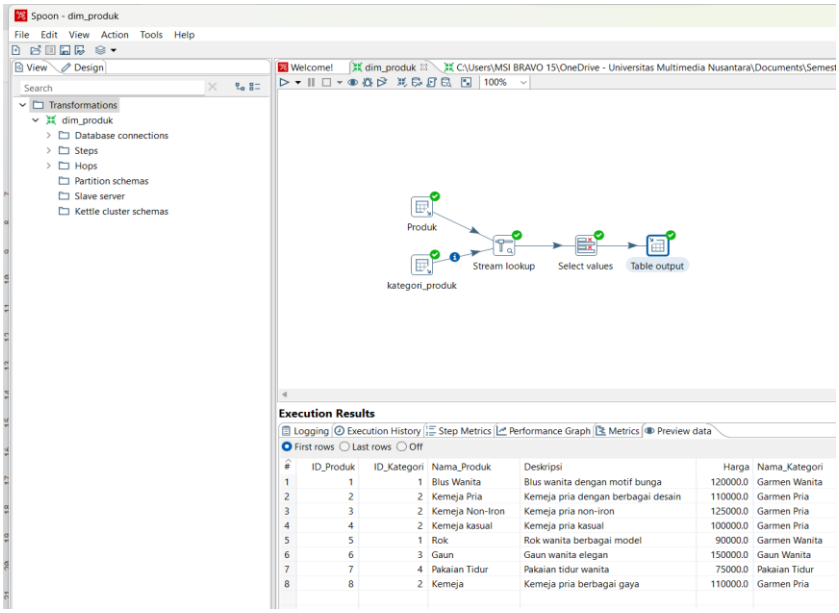


Fig 10. Product dimension table

From Figure 10 above, it can be seen that the product_dimensional table is a dimension table which is a combination of two tables, namely the ms_product table (Product_ID, Product_Name, Description, Price) with ms_product_category (Category_ID, Category_Name) then a lookup is carried out, namely taking the value or values from both tables and selecting values to take the appropriate column and with the output table, a product dimension table is formed.

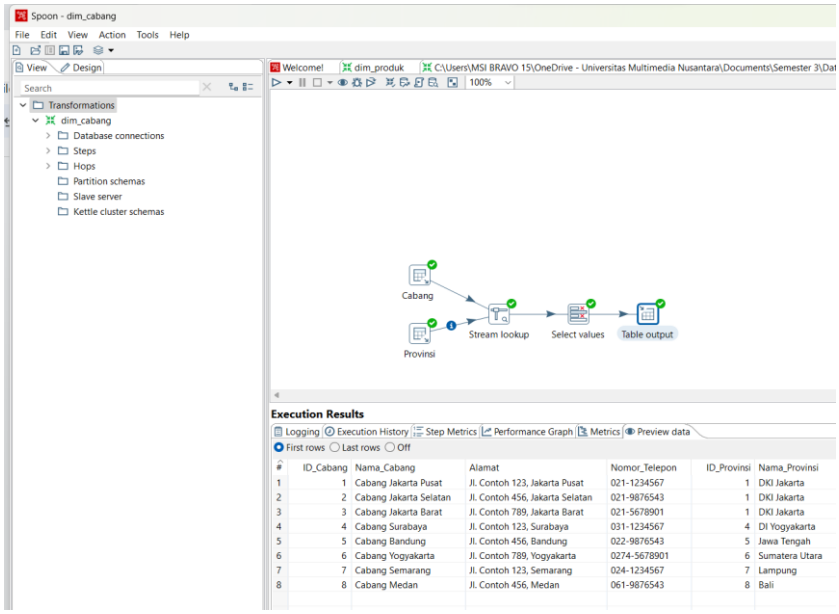
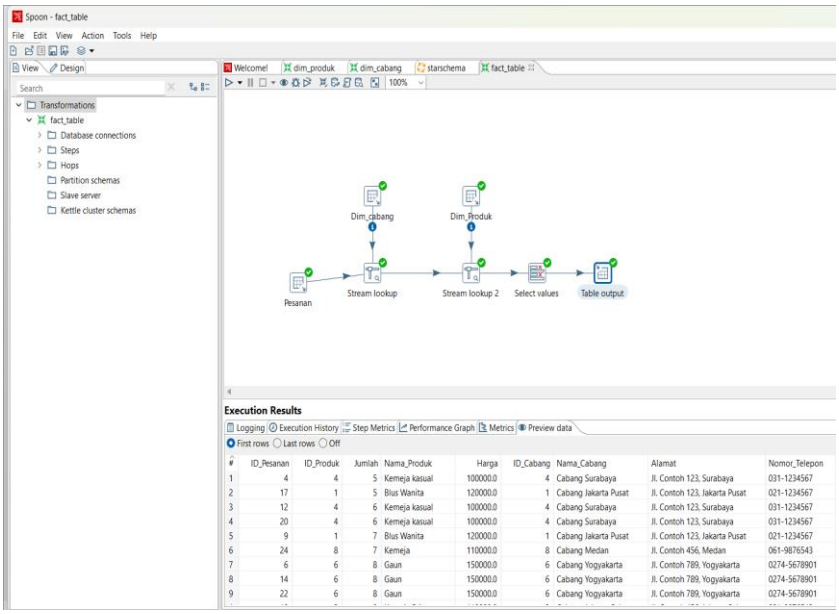


Fig 11. Branch dimension table

From Figure 11 above, it can be seen that the branch_dimensional table is a dimension table which is a combination of two tables, namely the ms_branch table (Branch_ID, Branch_Name, Address, Telephone_Number) with ms_provinsi (Provinsi_ID, Province_Name) then a lookup is carried out, namely taking the value

or values from both tables and selecting values to retrieve the appropriate column and with the output table, a branch dimension table is formed.



#	ID_Pesanan	ID_Produk	Jumlah	Nama_Produk	Harga	ID_Cabang	Nama_Cabang	Alamat	Nomor_Telepon
1	4	4	5	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
2	17	1	5	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
3	12	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
4	20	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
5	9	1	7	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
6	24	8	7	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
7	6	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
8	14	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
9	22	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901

Fig 12. Order fact table

From Figure 12 above, it can be seen that the order fact table is a fact table that is a combination of 3 tables, namely the branch_dimensional table (Branch_ID, Branch_Name, Address, Telephone_Number, Province_ID, Province_Name), but does not display Category_ID and Province_Name because the province does not need to be displayed but only the column necessary for the problem that has been formulated. Then there is the product_dimensional table (Product_ID, Product_Name, Description, Price, Category_ID, Category_Name), which also does not display Category_ID and Category_Name because categories are also not needed to display in the problem above. There is also an order table, which functions as a table that displays transactions or becomes a fact table because the fact table is transactional and selects values to take the appropriate columns. With the output table, a fact table is formed, which has the primary key as well as the foreign keys of the tables. dimensions above such as Branch_ID, Product_ID, Order_ID) and also other attributes such as Product_Name, Description, Price, Address, Telephone_Number.

Star schema requires 2 types of tables to be used as a star schema, whereas PT Golden Flower Tbk requires 2 types of tables, namely a dimension table, and a fact table, to perform a star schema. Star schema is very useful for companies. Creating wer star schema requires a dimension table and fact table, which have been created above. After completing a job containing tabular transformations from the dimensions and fact table above, a star schema can be made. Below is a display of the star schema.

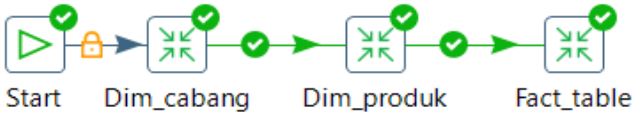


Fig13. Job with Star Schema

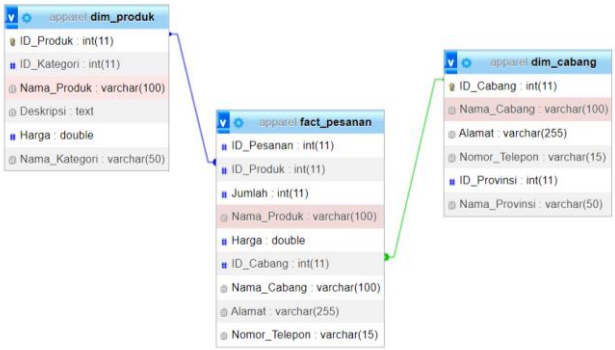


Fig 14. Star Schema Visualization

Figure 13 above is the star schema carried out in the Pentaho application. There are two dimension tables, namely branch and product dimensions, and one fact table, the order fact table. Then figure 14 is a visualization. In Figure 14 above, we can see that with the star schema created, PT Golden Flower obtained data processed more straightforwardly. This data can be used for the company's benefit by identifying its goals in solving its problems. This also makes it easier for companies to implement it to achieve the desired profits.

With the methods carried out above, from the dimension table to the fact table, this can be the leading solution to solve the problems at PT Golden Flower by knowing the orders from each branch. The fact table is created using an input table of 3 tables consisting of a product dimension table, branch dimension table, and order table by connecting. This table uses stream lookup and selects values to determine which columns are retrieved. So with the fact table, we can easily see which branches have orders.

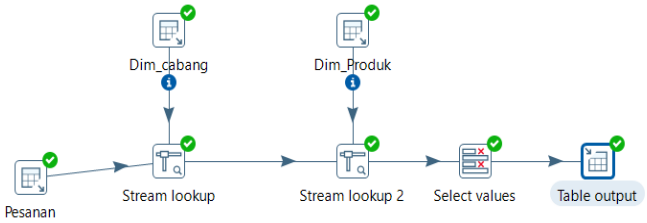


Fig 15. Solution with Star Schema 1

Execution Results

Logging | Execution History | Step Metrics | Performance Graph | Metrics | Preview data

First rows | Last rows | Off

#	ID_Pesanan	ID_Produk	Jumlah	Nama_Produk	Harga	ID_Cabang	Nama_Cabang	Alamat	Nomor_Telepon
1	4	4	5	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
2	17	1	5	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
3	12	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
4	20	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
5	9	1	7	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
6	24	8	7	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
7	6	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
8	14	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
9	22	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
1..	10	2	9	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	2	2	10	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	8	8	10	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
1..	18	2	10	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	16	8	11	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
1..	5	5	12	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	21	5	13	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	13	5	14	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	23	7	14	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
1..	1	1	15	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
2..	19	3	15	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901
2..	11	3	16	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901
2..	15	7	17	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
2..	7	7	18	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
2..	3	3	20	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901

Fig 16. Result from Star Schema 1

From Figure 16 above, it can be seen that from the fact table, each branch has its orders; some have a lot of orders, and some have few orders. By looking at these orders, the company can take policies such as holding promotions for branches whose orders are still small, such as the Surabaya branch, and adopt a policy to focus more on branches with many orders, such as the DKI Jakarta branch.

With the fact table above, we can also automatically analyze data on which consumers most order products. The fact table above was created using an input table from 3 tables consisting of a product dimension table, branch dimension table, and order table by connecting when these tables use stream lookup and select values to determine which columns are retrieved. Having a fact table can make it easier to see which products are sold the most.

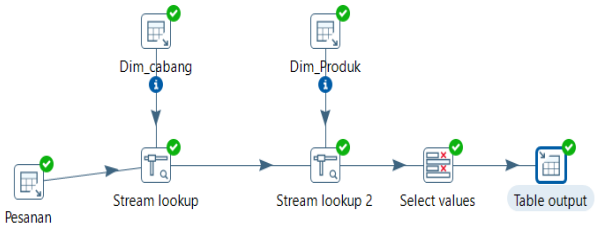
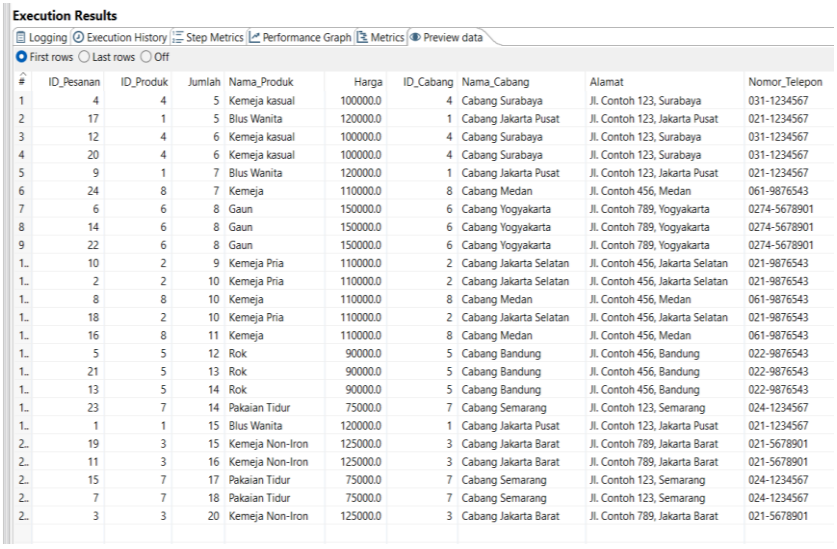


Fig. 17. Solution with Star Schema 2



Execution Results

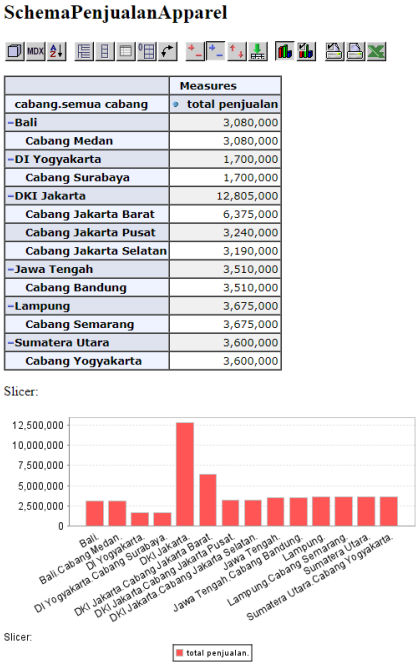
Logging | Execution History | Step Metrics | Performance Graph | Metrics | Preview data

First rows | Last rows | Off

#	ID_Pesanan	ID_Produk	Jumlah	Nama_Produk	Harga	ID_Cabang	Nama_Cabang	Alamat	Nomor_Telepon
1	4	4	5	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
2	17	1	5	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
3	12	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
4	20	4	6	Kemeja kasual	100000.0	4	Cabang Surabaya	Jl. Contoh 123, Surabaya	031-1234567
5	9	1	7	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
6	24	8	7	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
7	6	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
8	14	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
9	22	6	8	Gaun	150000.0	6	Cabang Yogyakarta	Jl. Contoh 789, Yogyakarta	0274-5678901
1..	10	2	9	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	2	2	10	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	8	8	10	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
1..	18	2	10	Kemeja Pria	110000.0	2	Cabang Jakarta Selatan	Jl. Contoh 456, Jakarta Selatan	021-9876543
1..	16	8	11	Kemeja	110000.0	8	Cabang Medan	Jl. Contoh 456, Medan	061-9876543
1..	5	5	12	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	21	5	13	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	13	5	14	Rok	90000.0	5	Cabang Bandung	Jl. Contoh 456, Bandung	022-9876543
1..	23	7	14	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
1..	1	1	15	Blus Wanita	120000.0	1	Cabang Jakarta Pusat	Jl. Contoh 123, Jakarta Pusat	021-1234567
2..	19	3	15	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901
2..	11	3	16	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901
2..	15	7	17	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
2..	7	7	18	Pakaian Tidur	75000.0	7	Cabang Semarang	Jl. Contoh 123, Semarang	024-1234567
2..	3	3	20	Kemeja Non-Iron	125000.0	3	Cabang Jakarta Barat	Jl. Contoh 789, Jakarta Barat	021-5678901

Fig 18. Result from Star Schema 2

Figure 18 shows that the fact table shows that the product that sells the most is non-iron shirts, of which 51 pcs were sold, so the company can take a policy, namely by increasing production of the most ordered product, such as non-iron shirts. A fact table makes it easy for companies to determine which products are sold the most. After the star schema has been successfully created, the next step is the solution via Mondrian with Schema Workbench, which will be displayed in pictures 19 and 20 below.

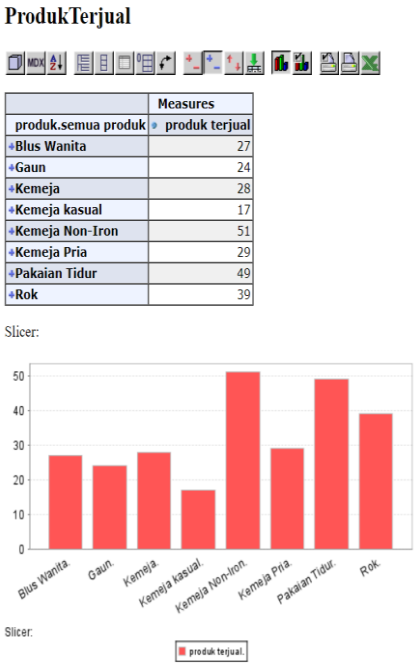


SchemaPenjualanApparel

	Measures
cabang.semua cabang	total penjualan
−Bali	3,080,000
Cabang Medan	3,080,000
−DI Yogyakarta	1,700,000
Cabang Surabaya	1,700,000
−DKI Jakarta	12,805,000
Cabang Jakarta Barat	6,375,000
Cabang Jakarta Pusat	3,240,000
Cabang Jakarta Selatan	3,190,000
−Jawa Tengah	3,510,000
Cabang Bandung	3,510,000
−Lampung	3,675,000
Cabang Semarang	3,675,000
−Sumatera Utara	3,600,000
Cabang Yogyakarta	3,600,000

Slicer:

Fig 19. Solution with Mondrian 1



ProdukTerjual

	Measures
produk.semua produk	produk terjual
+Blus Wanita	27
+Gaun	24
+Kemeja	28
+Kemeja kasual	17
+Kemeja Non-Iron	51
+Kemeja Pria	29
+Pakaian Tidur	49
+Rok	39

Slicer:

Fig 20. Solution with Mondrian 2

From Figure 19, it can be seen that the help of Mondrian and Schema Workbench can help the company, namely PT Golden Flower, find the most orders from sales at existing branches. And it can be seen that the branch with the most sales is DKI Jakarta. Knowing that the most significant sales are in DKI Jakarta, the company can take policies to maximize its sales at that branch and provide new policies such as promotions or annual discounts to branches with low sales, namely Surabaya and DI Yogyakarta.

From Figure 20, it can be seen that the help of Mondrian and Schema Workbench can help PT Golden Flower find products that sell a lot and are in demand by consumers. Where the most sold product is non-iron shirts, namely 51 pcs, the company can take a policy to produce more of this product to increase the company's profits. With Mondrian and Schema Workbench, it can make it easier for companies to determine which products will be sold the most.

D. Conclusion

The Pentaho Data Integration (PDI) Application, with Mondrian, and Star Schema help companies to manage large-scale data because it can be helped by using the ETL process, which extracts raw data, transforms data, or normalizes data, and loads data into a database. After the ETL process, the data can be used for further analysis. The dimensional and fact tables can help PT Golden Flower Tbk to solve problems and the fact tables are an essential solution for companies that want to know and identify data according to issues, such as knowing sales from each branch and which products consumers purchase the most. This method helps companies overcome data-related obstacles.

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