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Development of a Business Intelligence Dashboard for Performance Analysis of TheLook E-Commerce Based on a Data Warehouse

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Abstract

As digital transactions in e-commerce continue to grow, organizations require data processing systems capable of transforming large volumes of operational data into strategic information. This study aims to implement a Business Intelligence (BI) dashboard to support business analysis in TheLook E-Commerce. The study applies an Extract, Transform, Load (ETL) process, data warehouse development, data mart construction, and interactive data visualization. TheLook E-Commerce dataset consists of customer, product, order item, inventory, distribution center, and user activity data. The research process includes importing data into PostgreSQL, storing data in a staging area, developing a data warehouse using a star schema, creating a data mart, and visualizing data through a Tableau dashboard. The data warehouse consists of one fact table, fact_sales, and several dimension tables, including dim_customer, dim_product, dim_orders, dim_distribution_center, and dim_date. The implemented dashboard provides key business indicators such as revenue, profit, total orders, total customers, average order value, gross margin, product performance, order status distribution, customer segmentation, and sales trends. The results indicate that TheLook E-Commerce experienced growth in sales and profit margins. However, challenges remain in maintaining order volume and customer loyalty. Overall, the data warehouse-based BI implementation supports more effective business operations and decision-making processes.

Keywords: *Business Intelligence, Dashboard, Data Warehouse, E-Commerce, ETL*

1. Introduction

With the growth of e-commerce, businesses are becoming increasingly reliant on data. This includes not only sales data captured in every transaction, but also information about products, orders, shipping status, distribution locations, traffic sources, and customer behavior. E-commerce businesses require data processing that can transform transaction data into relevant business insights, as large volumes of operational data cannot necessarily be used directly—it is scattered across many tables, not yet integrated, and not presented in a form that is easy to understand [1], [2].

One approach to meeting this need is business intelligence, which works by integrating, processing, analyzing, and presenting data to support data-driven decision-making. In digital business, business intelligence helps companies monitor key performance indicators, such as sales trends, product performance, customer behavior, and the effectiveness of marketing channels [3], [4]. This information is easier to understand when presented through a concise, visual, and interactive dashboard [5]

The Extract, Transform, and Load (ETL) process is an integral part of Business Intelligence implementation. ETL is used to retrieve data from sources, transform its structure, cleanse it, and then load it into a data warehouse. The data warehouse itself serves as an integrated data repository designed for analytical purposes[6], [7]. With a well-structured data warehouse, various perspectives can be used to analyze transaction data from different angles, such as product, time, customer, order status, and sales distribution.

Data warehouses, Business Intelligence, and dashboards have been used in various types of research. Handika [1] used a data warehouse and Business Intelligence for inventory analysis, and Apriliani [2] discussed the evaluation of data warehouse and Business Intelligence management in e-commerce. According to other studies, clearer and more easily understood indicators on Business Intelligence dashboards can help customers understand the business situation [5]. However, some studies still focus on a single specific stage, such as designing a data warehouse alone or examining dashboards alone. In reality, a comprehensive Business Intelligence implementation must consider the

entire data processing workflow, starting from data sources, through the staging area, ETL, the data warehouse, data marts, and interactive dashboards.

Thus, this study focuses on the use of a Business Intelligence dashboard to evaluate the performance of TheLook's data warehouse-based e-commerce platform. The TheLook E-Commerce dataset was used because it represents e-commerce business processes that include data on customers, products, orders, order items, inventory, distribution centers, and user activities. The data was processed through the following stages: loading into PostgreSQL, creating a staging area, performing ETL using Pentaho Data Integration, designing a star schema-based data warehouse, creating data marts, and visualizing the dashboard using Tableau.

The research question in this study is how to use a data warehouse-based Business Intelligence dashboard to help evaluate the performance of TheLook's e-commerce platform. This problem encompasses the provision of business performance indicators via the dashboard, the design of the data warehouse and data marts, and the processing of operational data through ETL. Revenue, profit, total orders, total customers, average order value, gross margin, product performance, order status, customer segmentation, traffic sources, and sales trends are the indicators evaluated.

The purpose of this study is to develop a Business Intelligence dashboard capable of analyzing the performance of TheLook E-Commerce using ETL integration, a data warehouse, a data mart, and interactive visualizations. The results of this study are expected to provide an overview of how Business Intelligence can be used to transform e-commerce operational data into business insights that support data-driven decision-making.

2. Research Methods

This study employs an applied research method with a business intelligence development approach, as the focus of the research is to build an analytical system capable of transforming e-commerce operational data into business information that can be used for decision-making. The processes of data loading, the staging area, the Extract, Transform, Load (ETL) process, data warehouse construction, data mart creation, dashboard development, and business insight analysis are all part of the development process[6] [8].

The research dataset used is the TheLook E-Commerce Dataset. This dataset represents e-commerce business activities in the online sale of fashion products. The data consists of several main tables: users, orders, order_items, products, inventory_items, events, and distribution_centers. These tables contain information on customers, orders, transaction items, products, inventory, user activities, and distribution centers. This dataset was selected because its data structure is suitable for analyzing business performance in terms of sales, products, customers, time, and distribution.

The tools used in this study include PostgreSQL, DBeaver, Pentaho Data Integration, Microsoft Excel, and Tableau. PostgreSQL is used to store operational data, the staging area, the data warehouse, and the data mart. DBeaver is used to manage the database and run SQL queries. The ETL process is executed by Pentaho Data Integration. Microsoft Excel is used for initial dataset verification, while Tableau is used to create interactive dashboards.

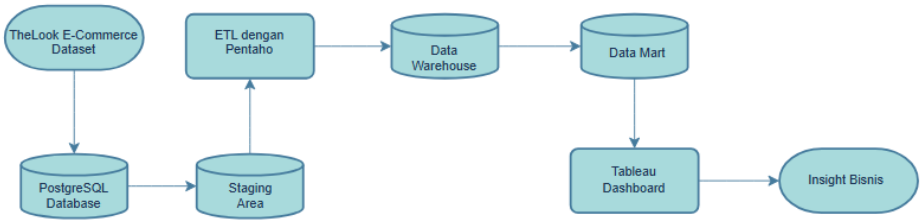

Figure 1: Research Methodology Flowchart

Based on Figure 1, the first stage involves loading the TheLook E-Commerce dataset into PostgreSQL as an operational database. The data is then transferred to a staging area for temporary storage before further processing. Data is extracted from the source, cleaned, and adjusted in terms of structure and attributes, and then loaded into the data warehouse during the ETL phase. The data warehouse is designed using a star schema approach consisting of one fact table, namely fact_sales, and five dimension tables, namely dim_customer, dim_product, dim_orders, dim_distribution_center, and dim_date.

The next step is to create data marts by combining the fact table and relevant dimension tables according to analytical needs. Data marts serve as the primary source for dashboards because they have a more concise structure and are ready for visualization. The metrics analyzed include revenue, profit, total orders, total customers, average order value, gross margin, quantity sold, product performance, customer segment, order status, traffic source, and sales trends over time.

The final stage involved creating an interactive dashboard using Tableau. The dashboard consists of four main pages: the Business Overview Dashboard, the Sales Analytics Dashboard, the Product Analytics Dashboard, and the Customer Analytics Dashboard. The analysis was descriptive in nature, based on Key Performance Indicators (KPIs) and the data visualizations displayed on the dashboard.

The results of the analysis were used to generate business insights regarding the sales, product, customer, and distribution performance of TheLook E-Commerce.

3. Result and Discussion

3.1. Data Warehouse Design

The data warehouse design was carried out based on the analysis requirements of TheLook E-Commerce business performance. The data used were obtained from the users, orders, order_items, products, inventory_items, events, and distribution_centers tables. These tables contain information regarding customers, orders, transaction items, products, inventory, user activities, and distribution centers. Before being loaded into the data warehouse, the data were processed in the staging area and through the Extract, Transform, and Load (ETL) stages using Pentaho Data Integration. The ETL process enables data from operational sources to be cleaned, adjusted, and structured according to analytical requirements.

The main business process analyzed in this study is the performance of TheLook E-Commerce. The analysis includes revenue, profit, number of orders, product performance, customer characteristics, order status, traffic sources, and sales trends. The grain or level of detail in the fact table was determined at the sales transaction item level. This means that each row in the fact table represents one transaction item connected to customer, product, order, distribution center, and transaction time data.

The TheLook E-Commerce data warehouse was designed using the star schema method. This structure consists of five dimension tables, namely dim_customer, dim_product, dim_orders, dim_distribution_center, and dim_date. The fact table, fact_sales, serves as the center for storing sales transaction data, while the dimension tables provide analytical context. The star schema is an appropriate choice because its structure is simple, easy to understand, and suitable for Business Intelligence dashboard requirements.

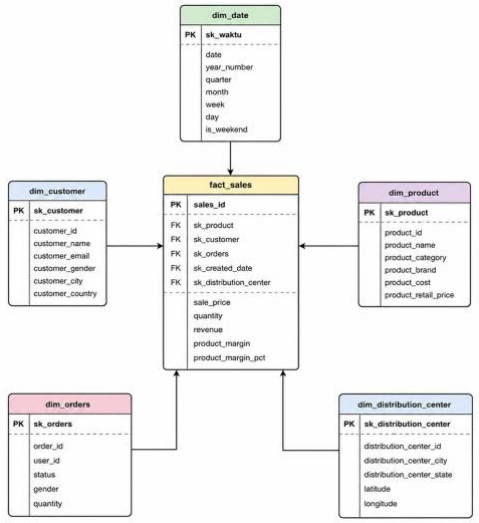

Figure 2: Star Schema Design of the TheLook E-Commerce Data Warehouse

Based on Figure 2, fact_sales becomes the main table with five dimension tables. The customer dimension is used to evaluate customer characteristics, the product dimension is used to evaluate categories and brands, the order dimension is used to evaluate order status, the distribution center dimension is used to evaluate distribution center locations, and the date dimension is used to evaluate sales trends over time.

Table 1: Identification of TheLook E-Commerce Data Warehouse Dimension Tables

No	Dimension Table	Analysis Function
1	dim_customer	Stores customer information such as identity, age, gender, location, and traffic source
2	dim_product	Stores product information such as category, brand, price, cost, margin, and price range
3	dim_orders	Stores order information such as order status and number of items
4	dim_distribution_center	Stores distribution center information and product distribution locations
5	dim_date	Stores time information for daily, monthly, quarterly, and yearly analysis

The fact table used is fact_sales, which contains sales transaction data and functions as the central relationship with the dimension tables. Several key measures used are sale_price, quantity, revenue, product_margin, and product_margin_pct. These measures are used to calculate revenue, the number of products sold, and product profitability.

Table 2: Main Structure of the Fact Table

Fact Table	Grain	Main Measures	Connected Dimension
fact_sales	Sales transaction item	sale_price, quantity, revenue, product_margin, product_margin_pct	dim_customer, dim_product, dim_orders, dim_distribution_center, dim_date

3.2. Data Mart Formation

Data mart formation began after the construction of the data warehouse. The fact_sales table and relevant dimension tables were combined to create a data mart because of its more concise structure and adaptation to analytical requirements. The data mart was used as the main source for the dashboard. With the data mart, visualization becomes more efficient because Tableau does not need to retrieve data directly from many operational tables.

The indicators prepared in the data mart include revenue, profit, total orders, total customers, average order value, gross margin, quantity sold, product performance, customer segment, order status, traffic source, and sales trends over time. These indicators were selected because they are able to provide an overview of how the business operates from the perspectives of sales, products, customers, and distribution.

Table 3: Analysis Indicators in the Data Mart

No	Indicator	Analysis Purpose
1	Revenue	Measures total revenue from sales transactions
2	Profit	Measures profit generated from sales
3	Gross Margin	Evaluates the level of business profitability
4	Total Orders	Calculates the number of order transactions
5	Total Customers	Calculates the number of customers
6	Average Order Value	Measures the average transaction value
7	Quantity Sold	Calculates the number of products sold
8	Customer Segment	Groups customers based on transaction contribution
9	Order Status	Observes the distribution of order status
10	Traffic Source	Observes the contribution of traffic sources to revenue

3.3. Implementation of the Tableau Dashboard

Using the data mart and Tableau, the Business Intelligence dashboard consists of four main pages: the Business Overview Dashboard, Sales Analytics Dashboard, Product Analytics Dashboard, and Customer Analytics Dashboard. These four pages are designed to provide different perspectives on TheLook E-Commerce performance.

The Business Overview Dashboard displays a summary of business performance, such as revenue, profit, total orders, total customers, average order value, and gross margin. The Sales Analytics Dashboard analyzes sales performance based on time, order status, and product categories. The Product Analytics Dashboard measures the contribution of brands and products to revenue. The Customer Analytics Dashboard analyzes customer characteristics and customer contributions to business performance.

Figure 3: TheLook E-Commerce Business Intelligence Dashboard Display

3.4. Dashboard Results Analysis

Based on the dashboard visualization results, TheLook E-Commerce generated total revenue of $61,945.94 with a profit of $36,640 and a gross margin of 59.16%. The number of recorded transactions reached 1,972 orders with a total of 1,930 customers. The revenue trend also showed an increase from year to year, with the highest value occurring in 2025 at $17,816.82. These results indicate that TheLook E-Commerce business performance is quite good because it is able to generate relatively high revenue and profit margins. The presentation of indicators such as revenue, profit, gross margin, number of orders, and number of customers through the dashboard is in line with the function of Business Intelligence as a tool for evaluating business performance based on measurable indicators [9].

However, the dashboard also shows several aspects that need attention. The percentage of canceled orders is still relatively high, reaching 23.99%, which has the potential to reduce the revenue that the company could have earned. In addition, the Search channel contributes more than 70% of revenue. This condition indicates that the channel is effective in generating revenue, but dependence on a single marketing channel can become a risk if its performance declines. Therefore, the company needs to evaluate the ordering process and expand other marketing channels, such as email marketing, organic traffic, social media, and referral. Monitoring indicators such as order status and traffic sources through the dashboard can help the company identify areas that need improvement more quickly [9].

In terms of products, there were 938 products successfully sold with a total quantity sold of 3,753 units. The Champion brand became the brand with the highest revenue, amounting to $3,069.61, followed by Capezio and Carhartt. These results indicate that revenue is still dominated by several major brands. Therefore, high-performing brands can be prioritized in promotional strategies and inventory management, while other potential brands can be developed through special promotions or product recommendations. Sales trend analysis through the Business Intelligence dashboard can also help companies understand the most demanded products and determine business strategies based on sales patterns displayed visually [10].

4. Conclusion and Suggestions

Based on the results of the research that has been conducted, the Business Intelligence dashboard for analyzing TheLook E-Commerce performance was successfully developed through the stages of data loading, staging area, ETL process, data warehouse design, data mart formation, and visualization using Tableau. The star schema approach was used to build the data warehouse, which consists of one fact table, fact_sales, and five dimension tables, namely dim_customer, dim_product, dim_orders, dim_distribution_center, and dim_date. This structure enables the integration of e-commerce operational data into more structured analytical data, which can be used as the source of the dashboard.

The developed dashboard consists of four main pages, namely the Business Overview Dashboard, Sales Analytics Dashboard, Product Analytics Dashboard, and Customer Analytics Dashboard. The visualization results show that the dashboard is capable of presenting business performance indicators, such as revenue, profit, total orders, total customers, average order value, gross margin, quantity sold, order status, product performance, customer segmentation, traffic sources, and sales trends. Thus, the developed dashboard can help users understand TheLook E-Commerce business performance in a more concise, visual, and focused manner.

The analysis results indicate that TheLook E-Commerce has fairly good business performance, as reflected by total revenue of $61,945.94, profit of $36,640, a gross margin of 59.16%, total orders of 1,972, and total customers of 1,930. However, there are still several aspects that need attention, namely the relatively high order cancellation rate, revenue dependence on the Search channel, and the low repeat customer rate of 2.12%. These findings indicate that the company needs to strengthen customer retention strategies, improve the transaction experience, and expand marketing channels so that business performance can grow more sustainably.

Suggestions for future research include adding a dashboard evaluation process by end users, such as data analysts, business managers, or parties involved in decision making. This evaluation can be used to determine the level of usability, visualization readability, and the suitability of dashboard information with business needs. In addition, future studies can incorporate predictive analysis, such as sales forecasting, customer classification, or product recommendations, so that the dashboard not only provides descriptive analysis but also supports more proactive business planning. System development can also be directed toward automatic data integration so that the information displayed on the dashboard becomes more up to date.

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