

UNIVERSITY OF ECONOMICS AND LAW  
FACULTY OF INFORMATION SYSTEMS



**FINAL PROJECT REPORT**

**DATA VISUALIZATION**

**Topic:**

**IMPLEMENTING THE WIDE WORLD IMPORTERS DATA WAREHOUSE: A STRATEGIC MOVE TOWARDS DATA-DRIVEN DECISION MAKING FOR ENHANCED BUSINESS PERFORMANCE**

*Supervisor: Master Nguyen Phat Dat*

**Ho Chi Minh City, August 9, 2023**

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**Ho Chi Minh City, August 9, 2023**

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Despite our best effort, mistakes are inevitable. Therefore, we are glad to receive your judges and comments in order to improve our research. Those will be our enormous motivation to develop our project on the horizon.

## **COMMITMENT**

We commit that our final Visualization project is unique due to the whole team's research. There are still some documents we referenced from, we have listed and cited particularly in the report.

If all of the above are wrong, we will take all responsibilities from professors.

Wednesday, 9<sup>th</sup> August 2023

Committed group

Team 2

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## **CHAPTER 1. INTRODUCTION**

### **1.1. Business case for the project**

Our group business case is to implement Wide World Importers data warehouse for Business Intelligence. As Wide World Importers (WWI) is a global import and export company that deals with a wide range of products, in order to keep up with the growing competition in the market, WWI needs to make data-driven decisions to improve their business performance. Our group proposes implementing the Wide World Importers data warehouse to support their business intelligence needs

### **1.2. Objectives of the project**

#### **1.2.1. General Objective**

To implement the Wide World Importers data warehouse as a centralized data source to support WWI's business intelligence needs.

#### **1.2.2. Specific Objectives**

Firstly is to centralize the data from various business processes and transactions into a single source of truth. Secondly is to provide accurate and timely information for decision making to WWI's stakeholders. Finally is to enable better forecasting, planning, and performance monitoring for WWI's business operations.

The specific objectives are more focused and measurable, and are directly aligned with the general objective of implementing the data warehouse. These objectives provide a clear roadmap for the project and help to ensure that the project stays on track and meets its intended goals.

### **1.3. Research Objects**

Business processes and transactions: These are the key activities and operations that are carried out by WWI, and are the primary source of data for the data warehouse. The research may focus on identifying the types of processes and transactions that need to be captured in the data warehouse, and how they can be standardized and streamlined to ensure data accuracy and consistency.

Data sources: These are the systems, applications, and other sources that generate data



for WWI. The research may focus on identifying the key data sources, assessing the quality and consistency of the data, and developing strategies for integrating the data into the data warehouse.

**Business intelligence tools:** These are the software applications and tools that are used to analyze and visualize the data in the data warehouse. The research may focus on identifying the appropriate BI tools that can be integrated with the data warehouse, assessing their capabilities and limitations, and developing strategies for leveraging their functionalities to support WWI's decision-making.

**Performance metrics:** These are the measures that are used to evaluate the effectiveness and efficiency of WWI's business operations. The research may focus on identifying the key performance metrics, assessing their relevance and validity, and developing strategies for tracking and reporting them using the data in the data warehouse.

#### **1.4. Scope of the research**

The scope of this project is to implement the Wide World Importers data warehouse and set up the necessary infrastructure to support the BI solutions. The project will involve the following steps:

- **Data warehouse design and development:** The database will be designed to support the required data structures and relationships, and populated with data from WWI's various business processes and transactions.
- **Data integration:** The data warehouse will be integrated with other data sources and systems to ensure that the data is up-to-date and consistent.
- **BI solutions:** BI solutions will be proposed and visualized in the data warehouse, helping the company have a better overview of the data warehouse built from the WWI dataset.
- **Testing and deployment:** The data warehouse and the BI solutions will be tested and deployed to ensure that they meet the requirements and perform as expected.

#### **1.5. Value and desired outcome of the project**

**Improved decision-making:** The data warehouse can provide accurate and up-to-date information to support data-driven decision-making for WWI's stakeholders. This can help

them identify opportunities for growth, optimize their resources, and mitigate risks.

**Increased efficiency:** By centralizing their data and automating data processing and analysis, WWI can save time and effort for their employees. This can lead to faster response times, better productivity, and improved customer service.

**Better forecasting and planning:** With historical and current data, WWI can use the database to forecast future trends and plan their business operations accordingly. This can help them optimize their resources, minimize risks, and stay competitive in the market.

**Enhanced customer service:** By having access to customer data, WWI can personalize their services and improve customer satisfaction. This can also help them identify potential opportunities for cross-selling and upselling.

The desired outcome of the project is to provide WWI with a powerful tool for supporting their business intelligence needs. The project should result in a functional database that is integrated with the necessary infrastructure and BI solutions.

## **1.6. Structure of project**

### *Chapter 1: Introduction*

This section should provide an overview of the project, including its background, objectives, and desired outcomes. It should also include a brief description of WWI's business operations and the challenges that the project aims to address.

### *Chapter 2: Theoretical Basis*

This section discusses the theoretical basis of BI solutions, including ETL, KPI and visualization techniques such as which dashboard in use, charts and colors selection. These concepts and principles provide the foundation for developing a BI solution for WideWorldImporters.

### *Chapter 3: Study Framework*

This section focuses on the design and development of the data warehouse for WideWorldImporters, as well as the extraction, transformation, and loading (ETL) of data from

various source systems. The integration of data into the data warehouse and implementation of data quality and data governance processes are also discussed.

#### *Chapter 4: Results – Data Analytics And Visualization*

In this section, data analytics and visualization solutions for WideWorldImporters are developed. Dashboards and reports are created to track KPIs and metrics, and advanced analytics techniques are used to analyze business trends and patterns. Insights and recommendations are presented to business stakeholders based on the results of the data analysis.

#### *Chapter 5: Conclusion and Future Works*

The final section summarizes the project outcomes and achievements, discusses lessons learned and challenges faced during the project, and provides suggestions for future improvements and enhancements to the BI solutions. The project concludes with final thoughts and conclusions on the BI solution for WideWorldImporters data warehouse.

## **CHAPTER 2. THEORETICAL BASIS**

### **2.1. Data Visualization**

Data visualization refers to the graphical representation of data using visual elements such as charts, graphs, maps, and other visual aids. Its primary purpose is to communicate complex information, patterns, trends, and insights in a clear and easily understandable manner. By presenting data visually, data visualization enhances comprehension, facilitates decision-making, and helps to uncover relationships and patterns that might not be apparent through raw data alone.

Effective data visualization involves selecting the appropriate type of visualization for the data being presented, designing the visual elements in a way that accurately represents the data and highlights key points, and ensuring that the visualizations are accessible and easy to interpret by a wide audience. Data visualization is widely used in various fields, including business, science, academia, journalism, and more, to convey information and tell stories through visuals that engage and inform the viewer.

Data visualization is used in many fields to represent and communicate information effectively, aiding understanding, analysis, and decision-making. Data visualization is essential for several compelling reasons:

- Enhanced Understanding
- Insight Discovery
- Decision Making
- Effective Communication
- Storytelling
- Comparisons and Analysis
- Quick Identification of Anomalies
- Effective Reporting

### **2.2. Data Dashboard**

Our project is utilizing the "Wide World Imposter" dataset provided by Microsoft. This dataset has been chosen with the aim of offering a diverse and engaging collection of

information, encompassing various business elements, statistics, and other crucial aspects. We have recognized the potential of this dataset for conducting the ETL (Extract, Transform, Load) process, which involves creating dimension and fact tables, and ultimately utilizing them for data visualization in a vivid and informative manner.

A data dashboard is a visualization tool that provides a quick and easily understandable overview of key performance indicators (KPIs) related to an organization's operations. Similar to an automobile dashboard, which provides essential information to the driver, a data dashboard offers real-time insights into an organization's performance, helping decision-makers operate and maintain their organizations effectively and efficiently.

Data dashboards typically display multiple outputs or KPIs, which may update in real time. These outputs are aligned with the organization's goals and can be used to monitor current and potential future performance on an ongoing basis. By consolidating and presenting data from various sources in a visual format designed for specific purposes, data dashboards can help organizations better understand and use their data for improved decision-making.

### **2.2.1 Principles of Effective Data Dashboards**

**Single-Screen Display:** Ideally, a data dashboard should present all KPIs related to a specific aspect of the organization's operations on a single screen, allowing users to quickly and accurately understand the current state of operations.

**Clarity and Relevance:** The KPIs displayed should quickly and clearly convey meaning to the user and be related to the decisions they make. Different users, such as marketing managers or chief financial officers, may have different KPIs tailored to their specific needs.

### **2.2.2 Applications of Data Dashboards**

**Sales Dashboard:** This dashboard is a visual representation of sales-related data and key performance indicators (KPIs) presented in a graphical format. It provides a comprehensive overview of a company's sales activities, performance, and trends.

**Order Dashboard:** An order dashboard is a visual representation of order-related data and information presented in a graphical format. It provides an overview of the order processing and fulfillment activities within a company.

**Product Dashboard:** A product dashboard is a visual representation of key data and metrics related to a company's products or services. It provides an overview of how products are performing in the market, their lifecycle stages, and other relevant information.

**Inventory and Shipment Dashboard:** This dashboard is used to manage and monitor various aspects of inventory and shipment processes within a business or organization.

**Purchase Dashboard:** A product dashboard is a visual representation of key data and metrics related to a company's products or services. It provides an overview of how products are performing in the market, their lifecycle stages, and other relevant information.

In summary, data dashboards offer a comprehensive view of an organization's performance across various domains, helping decision-makers efficiently manage and allocate resources. They can be customized to serve the unique needs of specific industries or functions within an organization, making them an indispensable tool for organizations that need to quickly understand and respond to rapidly changing KPIs.

In the upcoming chapter, we will delve deep into the ETL process, providing a detailed description of how we extract data from the Wide World Imposter dataset, transform it to ensure accuracy and consistency, and then load it into dimension and fact tables. The transparency in presenting this ETL process will offer an overarching view of how the data is pre-processed before being used in the visualization phase.

With this meticulous approach, we are striving to build a reliable and comprehensible data dashboard, enabling users to effortlessly track and analyze crucial information from the Wide World Imposter dataset.

## 2.3. Power BI

Power BI is a collection of software services, apps, and connectors by Microsoft that work together to turn unrelated sources of data into coherent, visually immersive, and

interactive insights. With Power BI, you can easily connect to a broad range of data sources, simplify data prep, and drive ad-hoc analysis. It offers robust visualization tools with which you can share insights across your organization, or embed them in an app or website. Power BI consists of three main elements: Power BI Desktop (a report authoring tool), Power BI Service (a SaaS-based service), and mobile Power BI apps for Windows, iOS, and Android devices. [1]

In our project, Power BI plays an instrumental role in data visualization and business intelligence. Given the vast amounts of data we've collected and processed, traditional data presentation methods proved insufficient and often overwhelming. With Power BI, we've transformed this data into interactive dashboards, providing stakeholders with a clear and concise view of key metrics and insights. These dashboards not only present data but also allow users to explore data layers in-depth, enabling informed decision-making. Our team has tailored these dashboards to cater to various departmental needs, ensuring relevance and ease of use.

## **2.4. KPIs**

Key Performance Indicators (KPIs) are measurable values that demonstrate how effectively a company is achieving key business objectives. Here are some KPIs for different departments within a company.

These KPIs can be customized and adapted to specific organizational goals and strategies. Monitoring these metrics provides valuable insights into various functions of the business and supports decision-making at all levels. Utilizing tools like Power BI, Tableau,... can further enhance the tracking, visualization, and interpretation of these critical metrics.

### **2.4.1 Sales**

**Sales Revenue:** Measures the income from sales activities over a specific time period, often used to track overall growth and success.

**Conversion Rate:** The percentage of leads that are converted into actual sales.

**Average Deal Size:** The average value of each sale, indicating the profitability of sales efforts.

**Sales Growth:** The percentage increase in sales over a specific time period, showing how rapidly the sales team is growing the business.

**Customer Acquisition Cost (CAC):** The average cost of acquiring a new customer, including marketing and sales expenses.

#### **2.4.2 Warehouse**

**Inventory Turnover:** Measures how many times the inventory is sold and replaced over a given period.

**Order Accuracy:** The percentage of orders shipped without errors, reflecting the effectiveness of the picking and shipping process.

**Warehousing Costs:** The total costs associated with storing goods, including rent, utilities, and personnel, used to identify areas for potential savings.

**On-time Shipping Rate:** The percentage of shipments sent on the scheduled date, reflecting efficiency and reliability.

#### **2.4.3 Product**

**Product Profit Margin:** The percentage difference between the cost to produce a product and its selling price.

**Customer Satisfaction Rate:** Measures customers' satisfaction with a product through surveys or feedback.

**Product Return Rate:** The percentage of sold products that are returned by customers, which may indicate quality issues.

**Time-to-Market:** The time taken from product development to its launch, showing the efficiency of the development process.



Market Share: The percentage of the total sales in a market captured by a particular product, indicating its competitiveness.

#### **2.4.4 Purchasing**

Purchase Order Cycle Time: The average time taken to fulfill a purchase order, reflecting efficiency in sourcing.

Supplier Lead Time: The time it takes for a supplier to deliver goods once an order is placed, affecting inventory planning.

Compliance Rate: The percentage of purchases made in compliance with purchasing policies and contracts, showing adherence to company guidelines.

Cost Savings from Negotiation: Measures the reduction in costs achieved through negotiation with suppliers.

Supplier Quality Rating: An assessment of suppliers based on quality, delivery, and responsiveness, used to identify the best partners.

### **2.5. Guidelines for Chart Selection**

In this part, we address the significance of data visualization in our project and provide a guide to selecting appropriate charts for the dashboard design. We focus on the key objectives of the data visualizations, and the importance of selecting the right charts for accurate and insightful data presentation. We also highlight the importance of considering the audience's needs and understanding the types of data being visualized. Based on the data analysis goals and types of data, we recommend the following chart types for the dashboard design.

#### **2.5.1 To Show Relationships**

Scatter charts: Recommended for displaying relationships between two quantitative variables.

Bubble charts: Suitable for dealing with three quantitative variables.

Line charts: Effective for emphasizing patterns across consecutive data points, especially for time series data.

Stock charts: Ideal for showing the relationship between time and stock price.

Column, bar, and heat maps: Appropriate for showing relationships between categories.

These charts visually depict the interaction between variables or categories, aiding in the identification of trends, correlations, or patterns.

### **2.5.2 To Show Distribution**

Scatter and bubble charts: Useful for showing how quantitative variables are distributed.

Column and bar charts: Suitable for displaying the distribution of a variable across discrete categories or time periods.

Choropleth maps: Effective for showing the distribution of variables across geographic areas.

These charts help in visualizing the spread, concentration, or distribution of data points, revealing insights such as outliers, clusters, or variations.

### **2.5.3 To Show Composition**

Bar charts: Appropriate for showing the composition of an entity, sorted by contribution.

Stacked bar or stacked column charts: Effective for displaying the composition of different categories or over time.

Treemaps: Suitable for displaying hierarchical structures among categorical variables.

Waterfall charts: Ideal for showing the composition of a quantitative variable over time or category.

Funnel charts: Appropriate for showing the composition of an original set from bottom to top.

These charts effectively display how different parts contribute to a whole, providing a clear understanding of the proportionate contribution of each component or category.

#### **2.5.4 To Show Ranking**

Bar or column charts: Recommended for showing the rank order of categories based on a quantitative variable, sorted on the cross-sectional quantitative data.

These charts allow for easy comparison of categories, helping users quickly identify top or bottom performers.

#### **2.5.5. Charts to Avoid**

In our dashboard design, we decided to avoid certain charts that can be cluttered, confusing, or misleading:

Pie charts: Instead, we used bar charts, as people are better at assessing differences in length than angle and area.

Radar charts: Due to their clutter, scaling issues, and potential for misleading interpretations.

Area charts: We opted for less cluttered alternatives like line charts or stacked column charts.

Combo charts: Especially those that are overly cluttered and difficult to interpret.

3D charts: As the third dimension typically adds no additional understanding and can lead to more clutter.

Selecting the right chart types is crucial for effective data visualization in the dashboard. The appropriate chart types facilitate understanding, support analytical objectives, and enable users to make informed decisions. The guidelines provided in this chapter helped us ensure that the charts used in our project's dashboard are effective and meaningful.

### **2.6. Data Visualization**

Data Visualization is a critical part within a report that covers the fundamental concepts and principles behind visual perception and how it affects the design of effective data

visualizations. This part discusses the roles of iconic memory, short-term memory, and long-term memory in visual perception, highlighting the importance of iconic and short-term memory for visual processing.

The chapter introduces the concept of preattentive attributes, which are visual features that are processed almost instantly by iconic memory, enabling viewers to quickly differentiate between elements in a visualization. These attributes include color, form, spatial positioning, and movement.

1. Color - This attribute encompasses hue (basic colors), saturation (color intensity), and luminance (amount of black or white in a color). Differences in color can create stark or subtle contrasts, effectively drawing attention to specific elements of a visualization. However, care must be taken not to overuse color and to consider color blindness.

2. Form - This preattentive attribute includes orientation, size, shape, length, and width. Orientation refers to the positioning of an object and is used in line graphs to illustrate trends. Size relates to the 2D space occupied by an object, but is difficult to judge accurately. Shape is typically used to group common items, and it does not usually convey quantitative information. Length and width refer to the dimensions of lines, bars, or columns, with length effectively illustrating quantitative values.

3. Spatial Positioning - The location of an object within a defined space is a crucial preattentive attribute. Scatter charts are common visualizations that use 2D spatial positioning to show relationships between variables.

4. Movement - Humans are attuned to detecting movement, including flicker (flashing) and motion (directed movement). Movement can be used to draw attention or show changes over time or space, but it must be used judiciously to avoid distraction.

The proper use of preattentive attributes reduces cognitive load, making it easier for viewers to interpret visualizations. Designers should strike a balance when employing these attributes, considering factors like color blindness and the difficulty of judging relative sizes accurately. Overall, this chapter emphasizes the importance of understanding visual perception

and preattentive attributes to design effective data visualizations.

## **2.7. Purposeful Use of Color in Data Visualization**

Color plays a pivotal role in data visualization, making complex information easier to understand and interpret. The judicious use of color can direct the viewer's attention, differentiate between data points, and communicate patterns and trends more effectively. However, misuse or overuse of color can confuse or mislead the audience, distorting the intended message. Consequently, it is imperative to use color purposefully and deliberately to communicate the intended message effectively. To employ color purposefully in data visualization, several key principles should be considered.

**Avoid Unnecessary Color:** Color can be a powerful tool for visual communication, but it should be used selectively. Before adding color, ask yourself if it serves a specific purpose or if the same information can be communicated more effectively using another chart element such as labels or patterns. Superfluous use of color can distract the viewer, reduce data-ink ratio, and make the chart harder to understand.

**Limit Color Use:** There is a limit to how much information can be effectively communicated using color. The human eye can only differentiate between a finite number of colors in a single view. Overwhelming the audience with an excessive number of colors may lead to confusion and hinder comprehension. Limit the color palette to a few key colors that are relevant to the data and message being conveyed.

**Use Color Contrast Effectively:** Ensure that the colors chosen are distinguishable from one another. Insufficient contrast between colors can create confusion and make it challenging for the audience to differentiate between chart elements. Select colors that stand out against each other, keeping in mind the background color and the colors of other elements in the chart.

**Maintain Consistency:** Consistency is key in color usage across multiple charts, graphs, or reports. Use the same colors to represent the same categories or data points across related visualizations. Inconsistent color usage can confuse the audience, making it difficult to draw comparisons and understand the relationships between the data.

**Consider Colorblindness:** Recognize that some members of your audience may have color vision deficiencies that affect their ability to perceive certain colors. Consider using colorblind-friendly palettes or employing patterns and textures to ensure that your visualizations are accessible to all viewers.

**Adapt to the Mode of Delivery:** Colors can appear differently depending on the medium in which they are viewed. Colors may look different in print compared to a computer screen or when projected. Test the colors in the intended medium of delivery and adjust as necessary to ensure that they convey the intended message effectively.

**Use Color to Highlight and Emphasize:** Use color to direct the viewer's attention to specific data points or trends that you want to emphasize. Highlighting critical information with color can make it stand out and help the audience focus on the most important aspects of the data.

**Consider Cultural Context:** Recognize that colors may have different meanings and associations across cultures. For example, red may be associated with danger in one culture and celebration in another. Choose colors that align with the cultural context of your audience and avoid colors that may have unintended connotations.

**Test and Iterate:** After selecting your color palette, test your visualizations with a diverse audience to gather feedback. Use this feedback to iterate and refine your color choices to ensure they effectively communicate your intended message.

By thoughtfully applying these principles, you can use color purposefully in data visualization to enhance the impact of your visualizations, convey information more effectively, and communicate your message clearly and compellingly.

This extended section provides a comprehensive overview of the essential principles for the purposeful use of color in data visualization, helping the reader understand the considerations needed to create more effective and accessible charts and graphs.

## **CHAPTER 3. STUDY FRAMEWORK**

### **3.1. Workflow**

The project's meticulously structured workflow embarks on a journey encompassing key phases, from initial conception to actionable insights. This strategic approach leverages the expertise of Requirement Analysis, Data Collection and Migration, ETL on Alibaba Cloud, Data Visualization with Power BI, and Insight Generation.

#### **3.1.1. Requirement Analysis**

The journey commences with Requirement Analysis, where stakeholders collaborate to crystallize objectives and expectations. This phase forms a bedrock of understanding, aligning analytical efforts with organizational goals.

#### **3.1.2. Data Collection and Cloud Migration**

The project proceeds by collecting the Wide World Importers (WWI) database from Microsoft sources and subsequently deploying it to Microsoft Azure. This orchestrated process ensures the seamless availability of the data in a scalable cloud environment. The cloud platform becomes a reliable repository for WWI data.

#### **3.1.3. ETL on Alibaba Cloud**

The crux of the workflow lies in the ETL phase, executed on Alibaba Cloud. Leveraging this cloud infrastructure, the collected data migrates from Azure to Alibaba Cloud through Alibaba Cloud RDS instances. Transformational processes, including data cleansing and structuring, are facilitated seamlessly. The Streaming ETL function of Alibaba Cloud DTS streamlines the data refinement process, ensuring the data is optimized for analysis.

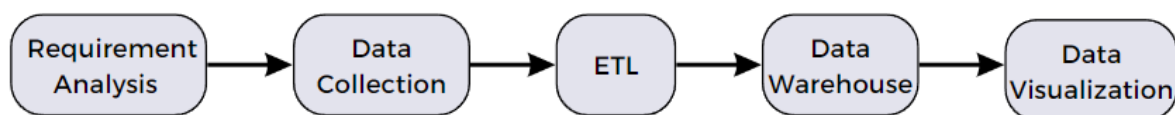
#### **3.1.4. Data Visualization with Power BI**

The processed and optimized data enters the Data Visualization phase, driven by Power BI. Through visually captivating dashboards, data trends, supplier dynamics, product summaries, inventory levels, and shipment intricacies are brought to life. Stakeholders effortlessly glean insights from graphs, charts, and heatmaps, enhancing decision-making capabilities.

#### **3.1.5. Insight Generation**

The project culminates with Insight Generation. Stakeholders explore the dashboards to unearth profound insights. These revelations span diverse realms, empowering strategic decision-making. Insights are harnessed to fine-tune procurement strategies, bolster supplier relationships, optimize inventory, and elevate shipment efficiencies.

The fluid integration of Requirement Analysis, Data Collection, Cloud Migration, ETL on Alibaba Cloud, Data Visualization, and Insight Generation cements a powerful workflow. This sequence is uniquely designed to seamlessly navigate the data journey, enabling the organization to harness data as a driving force for informed choices and sustainable growth. Through this dynamic workflow, the organization evolves into a data-driven powerhouse, leveraging insights to secure a competitive edge in the procurement landscape.



### 3.2. Requirements analysis

At the forefront of the analysis endeavor is the imperative to define the scope of data inclusion. This entails delving into various facets of procurement operations, such as purchases, suppliers, products, order trends, inventory, and shipments. By comprehensively delineating the scope, the analysis is poised to encapsulate a holistic view of the organization's procurement landscape, ensuring that insights are contextually rich and directly pertinent to strategic decision-making.

**Identifying Performance Metrics Requirement:** To derive actionable insights, it is essential to identify the specific performance metrics that will be scrutinized. Metrics such as supplier performance, order frequency, inventory turnover, and shipment efficiency serve as focal points. This requirement underscores the significance of tailoring the analysis to key performance indicators, thereby allowing stakeholders to measure the effectiveness of procurement strategies against established benchmarks.

**Leveraging Data Collection Sources Requirement:** The project's success hinges on the



meticulous identification of data sources. The project taps into Wide World Importers' database from Microsoft, strategically deployed within the Azure cloud environment. By harnessing this robust infrastructure, the organization ensures the accessibility, security, and scalability of the data, forming a resilient foundation for subsequent analysis.

**Seamless Cloud Services Integration Requirement:** To navigate the intricacies of data migration and transformation, the integration of Alibaba Cloud services comes to the forefront. Embracing tools like Alibaba Cloud RDS and DTS streamlines the extraction, transformation, and loading processes. This requirement culminates in an agile, cloud-based ecosystem that accelerates data refinement and harmonization.

**Facilitating Data Transformation Requirement:** The transformative aspect of data analysis demands a meticulous approach to data preparation. This requirement underscores the importance of data transformation processes, encompassing data cleansing, normalization, and structuring, as integral steps during ETL on Alibaba Cloud. These processes form the bedrock for data accuracy, enhancing the reliability of subsequent insights.

**Crafting Effective Visualization Objectives Requirement:** The visualization stage hinges on well-defined objectives. By delineating visualization goals, including the creation of dashboards such as Purchasing Analysis, Order Trend, Product Summary, Inventory, and Shipments Dashboards, this requirement ensures that the insights culminate in visually engaging formats. These dashboards become the conduit through which stakeholders can effortlessly grasp and interpret complex data patterns.

**Nurturing Cross-Functional Collaboration Requirement:** An endeavor of this nature thrives on collaborative synergy. The requirement for cross-functional collaboration underscores the need for engagement from procurement, IT, and data analysis teams. By fostering this interdisciplinary collaboration, the analysis encapsulates diverse expertise, leading to insights that are not only data-driven but also contextually relevant.

**Adhering to Regulatory Compliance Requirement:** The handling of sensitive information necessitates meticulous compliance with data privacy and regulatory standards. This requirement acknowledges the significance of ethical data practices, particularly when

dealing with sensitive data related to edible novelties. By incorporating stringent compliance measures, the organization ensures data security and legal adherence.

Envisioning International Expansion Readiness Requirement: Looking beyond the immediate horizon, the readiness for potential international expansion becomes a focal point. Evaluating the adaptability of data insights to various markets ensures that the analysis remains versatile. This requirement primes the organization to proactively respond to opportunities in global procurement landscapes.

Through a comprehensive assessment of these business requirements, the Requirement Analysis phase charts a course that harmonizes procurement goals, data potential, and strategic aspirations. These requirements crystallize the foundation upon which actionable insights will be built, steering the organization towards a future fueled by data-driven excellence.

### **3.3. Business Requirements Document & Business Requirements System**

#### *IT Requirements Analysis for Sale Department:*

- Sales Dashboard: The sales department needs a dashboard that provides real-time sales data, including sales volume, revenue, and customer insights. The dashboard should be easy to use, customizable, and accessible from any device.
- RFM analysis for Customer Segmentation (RFM): The sales department requires a customer segmentation that can manage customer data, track customer interactions, and provide insights for targeted marketing campaigns.
- Sales Order Management System: The sales department requires an order management system that can track sales orders, inventory levels, and delivery schedules. The system should be integrated with the warehouse and logistics systems to ensure timely delivery and accurate inventory management.

#### *IT Requirements Analysis for Purchase Department:*

- Purchase Order Management System: The purchase department requires a purchase order management system that can manage purchase orders, vendor information, and inventory levels. The system should be integrated with the accounting system to facilitate payment processing.
- Vendor Management System: The purchase department requires a vendor

management system that can manage vendor data, track vendor performance, and facilitate vendor communication.

- Purchase Request System: The purchase department requires a purchase request system that can manage purchase requests, approvals, and budget tracking. The system should be integrated with the financial and accounting systems to ensure accurate budget tracking.

#### *IT Requirements Analysis for Warehouse Department:*

- Warehouse Management System: The warehouse department requires a warehouse management system that can manage inventory levels, track inventory movements, and facilitate picking and packing operations.
- Logistics Management System: The warehouse department requires a logistics management system that can manage shipping schedules, track shipments, and provide real-time delivery updates. The system should be integrated with the sales and purchase order systems to ensure accurate order fulfillment.

#### *Overall IT Requirements Analysis:*

- Data Integration: The various IT systems across different departments should be integrated to ensure smooth data flow and facilitate accurate reporting and analysis.
- Data Security: All IT systems should have robust security measures in place to protect sensitive data, prevent unauthorized access, and ensure compliance with regulations and standards.
- Scalability: All IT systems should be scalable to accommodate future growth and changing business needs.
- Cloud-based Infrastructure: The IT infrastructure should be cloud-based to facilitate remote access, reduce maintenance costs, and improve scalability and reliability.

### **3.4. Data Warehouse Design**

#### **3.4.1. Source database Wide World Imposters**

Our source database is Wide World Imposter, a database conducted by Microsoft. The database story is about the business of Wide World Imposter (WWI), who operates as a prominent wholesale importer and distributor specializing in novelty goods, with its operational hub situated in the vibrant vicinity of the San Francisco Bay Area.

In the capacity of a wholesale entity, WWI primarily serves a client base composed of companies engaged in the resale of goods to individual consumers. WWI's extensive clientele spans the expanse of the United States, encompassing an array of retail establishments such as specialty boutiques, supermarkets, electronics emporiums, souvenir shops nestled in tourist havens, and even catering to select individual patrons. Facilitating its distribution network, WWI fosters partnerships with other wholesalers through a cadre of dedicated agents who tirelessly champion WWI's diverse product catalog. While the entirety of WWI's customer base currently calls the United States home, the company harbors ambitious plans to transcend borders and facilitate a triumphant international expansion endeavor.

In the pursuit of sourcing an eclectic range of merchandise, WWI engages in procurement transactions with a consortium of suppliers that encompass manufacturers specializing in novelty and toy production, as well as fellow wholesalers entrenched in the realm of curiosities. These acquisitions find their abode within the confines of the sprawling WWI warehouse, serving as a repository for inventory. Restocking is meticulously orchestrated in response to customer orders, ensuring seamless order fulfillment. Further enhancing their value proposition, WWI undertakes sizable acquisitions of packaging materials, proffering the convenience of obtaining these in smaller quantities to its customer base.

A noteworthy pivot in WWI's business landscape lies in its recent foray into the realm of edible novelties, a distinct category including products like chili-infused chocolates. This expansion necessitated a paradigm shift in their operational infrastructure, particularly in the sphere of temperature-sensitive items. Previously uncharted territory, WWI now navigates the intricacies of complying with stringent food handling regulations. This pivotal development obliges WWI to meticulously monitor the temperature fluctuations within their specialized chiller room, a domain now integral to their operations, as well as within the confines of their fleet of delivery trucks housing dedicated chiller sections.

As WWI steers through this dynamic and evolving landscape, its commitment to excellence, adaptability, and customer-centric practices stands as a testament to its enduring impact within the wholesale novelty goods industry.

### **3.4.2. Data Warehouse Design**

### 3.4.2.1. Bus Matrix

A bus matrix is a consolidated tabular view that depicts the relationships between dimension and fact tables. A bus matrix enables you to identify easily which facts share the same dimension(s). By using this information, you can assess which tables can be combined into one report. After defining business process, fact and common dimension tables, here are our bus matrix:

*Table 2: Bus Matrix*

	Common Dimension						
Business process	Date	Customer	Employee	Location	StockItem	Supplier	Transaction Type
<b>Sales</b>							
Sales Invoice Management	x	x	x	x	x		
<b>Purchase</b>							
Manage orders from suppliers	x				x	x	
<b>Warehouse</b>							
Movements of stock items	x	x			x	x	x

### 3.4.1.2. Transactional and master data for fact and dimension tables

Dim Date

*Table 3: Transactional and master data for Dim Date*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
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DateKey	A unique identifier for each date in the dataset.	date			
Date	The actual date in the format yyyy-mm-dd.	datetime	x	x	
FullDate	A combination of the date, month, and year in the format yyyy-mm-dd.	char(10)	x	x	
DayOfMonth	The day of the month, represented as a numeric value.	varchar( 2)	x	x	
DayName	The name of the day of the week (e.g. Monday, Tuesday), represented as a text value.	varchar( 9)	x	x	
DayOfWeek	The day of the week, represented as a numeric value (e.g. 1 for Monday, 2 for Tuesday).	char(1)	x	x	
DayOfWeekIn Month	The position of the day in the week within the month, represented as a numeric value (e.g. the first Monday in a month would have a value of 1).	varchar( 2)	x	x	
DayOfWeekIn Year	The position of the day in the week within the year, represented as a numeric value (e.g. the first Monday of the year would have a value of 1).	varchar( 2)	x	x	

DayOfQuarter	The day of the quarter, represented as a numeric value.	varchar(3)	x	x	
DayOfYear	The day of the year, represented as a numeric value.	varchar(3)	x	x	
WeekOfMonth	The week of the month, represented as a numeric value.	varchar(1)	x	x	
WeekOfQuarter	The week of the quarter, represented as a numeric value.	varchar(2)	x	x	
WeekOfYear	The week of the year, represented as a numeric value.	varchar(2)	x	x	
Month	The month of the year, represented as a numeric value (e.g. 1 for January, 2 for February).	varchar(2)	x	x	
MonthName	The name of the month (e.g. January, February), represented as a text value.	varchar(9)	x	x	
MonthOfQuarter	The month of the quarter, represented as a numeric value.	varchar(2)	x	x	
Quarter	The quarter of the year, represented as a numeric value (e.g. 1 for Q1, 2 for Q2).	char(1)	x	x	

QuarterName	The name of the quarter (e.g. Q1, Q2), represented as a text value.	varchar(9)	x	x	
Year	The year, represented as a numeric value.	char(4)	x	x	
YearName	The year, represented as a text value (e.g. "2023").	char(7)	x	x	

MonthYear	A combination of the month and year in the format yyyy-mm.	char(10)	x	x	
MMYYYY	A combination of the month and year in the format mmyyyy.	char(6)	x	x	
FirstDayOfMonth	The first day of the month, represented as a date in the format yyyy-mm-dd.	date	x	x	
LastDayOfMonth	The last day of the month, represented as a date in the format yyyy-mm-dd.	date	x	x	
FirstDayOfQuarter	The first day of the quarter, represented as a date in the format yyyy-mm-dd.	date	x	x	
LastDayOfQuarter	The last day of the quarter, represented as a date in the format yyyy-mm-dd.	date	x	x	
FirstDayOfYear	The first day of the year, represented as a date in the format yyyy-mm-dd.	date	x	x	



LastDayOfYear	The last day of the year, represented as a date in the format yyyy-mm-dd.	date	x	x	
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#### Dim Customer

*Table 4: Transactional and master data for Dim Customer*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
CustomerKey	DW key for the customer dimension	int			
CustomerId	Numeric ID used for reference to a	int	x	x	

	customer within the WWI database				
CustomerName	Customer's full name (usually a trading name)	nvarchar(100)	x	x	
CategoryName	Customer's category	nvarchar(50)	x	x	
AccountOpened Date	Date of Customer's account opened	date	x	x	
PrimaryContact PersonID	Primary contact	int	x	x	

PotalCode	Delivery postal code for the customer	nvarchar(10)	x	x	
PhoneNumber	Phone number of customer	nvarchar(20)	x	x	

## Dim Employee

*Table 5: Transactional and master data for Dim Employee*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
EmployeeKey	DW key for the employee dimension	int			
EmployeeId	Numeric ID (PersonID) in the WWI database	int	x	x	
FullName	Full name for this person	nvarchar(50)	x	x	
PreferredName	Name that this person prefers to be called	nvarchar(50)	x	x	

IsSalesperson	Is this person a staff salesperson?	bit	x	x	
PhoneNumber	Phone number of employee	nvarchar(20)	x	x	
FaxNumber	Fax number of	nvarchar(20)	x	x	

	employee				
EmailAddress	Email of employee	nvarchar(256)	x	x	

## Dim Location

*Table 6: Transactional and master data for Dim Location*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
LocationKey	A unique identifier for each location in the dataset.	int			
CityID	A unique identifier for each city in the dataset.	int	x	x	
CityName	The name of the city where the location is located.	nvarchar(50)	x	x	
StateProvince Name	The name of the state or province where the location is located.	nvarchar(50)	x	x	
SalesTerritory	The name of the sales territory where the location is located.	nvarchar(50)	x	x	

## DimStockItem

*Table 7: Transactional and master data for Dim StockItem*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
StockItemKey	Color (optional) for this stock item	int			
StockItemID	Numeric ID used for reference to a stock item within the WWI database	int	x	x	
StockItemName	Full name of a stock item (but not a full description)	nvarchar(100)	x	x	
UnitPrice	Selling price (ex-tax) for one unit of this product	decimal(18, 2)	x	x	
Brand	Brand for the stock item (if the item is branded)	nvarchar(50)	x	x	
Size	Size of this item (eg: 100mm)	nvarchar(20)	x	x	
IsChillerStock	Does this stock item need to be in a chiller?	bit	x	x	

LeadTimeDays	Number of days typically taken from order to receipt of this stock item	int	x	xx	
ColorName	Color (optional) for this stock item	nvarchar(20)	x	x	

QuantityPerOuter	Quantity of the stock item in an outer package	int	x	x	
Barcode	Barcode for this stock item	nvarchar(50)	x	xx	

Dim Supplier

*Table 8: Transactional and master data for Dim Supplier*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
SupplierKey	DW key for the supplier dimension	int			
SupplierId	Numeric ID used for reference to a supplier within the WWI database	int	x	x	

SupplierName	Supplier's full name (usually a trading name)	nvarchar(100)	x	x	
SupplierCategory Name	Supplier's category	nvarchar(100)	x	x	
PhoneNumber	Phone number of supplier	nvarchar(20)	x	x	
FaxNumber	Fax number of supplier	nvarchar(20)	x	x	
SupplierReference	Supplier reference for our organization (might be our account number at the supplier)	nvarchar(20)	x	x	

Postalcode	Delivery postal code for the supplier	nvarchar(10)	x	x	
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Dim Transaction Type

*Table 9: : Transactional and master data for Dim Transaction Type*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
TransactionTypeKey	DW key for the transaction type dimension	int			

TransactionTypeId	Numeric ID used for reference to a transaction type within the WWI database	int	x	x	
TransactionType	Full name of the transaction type	nvarchar(50)	x	x	

## Fact Sales

*Table 10: Transactional and master data for Fact Sales*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
SaleKey	DW key for a row in the Sale fact	int			
EmployeeKey	Employee for this invoice	int	x		
LocationKey	Location for this invoice	int	x		
CustomerKey	Customer for this invoice	int	x		

StockItemKey	Stock item for this invoice	int	x		
DateKey	Date for this invoice	date	x		
InvoiceID	InvoiceID in source system	int	x		

Quantity	Quantity supplied	int	x	x	
UnitPrice	Unit price charged	decimal(18, 2)	x	x	
TaxRate	Tax rate applied	decimal(18, 3)	x	x	
TaxAmount	Total amount of tax	decimal(18, 2)	x	x	
LineProfit	The profit earned from a single line item in a transaction, calculated as ExtendedPrice - TotalCost.	decimal(18, 2)	x	x	
TotalCost	Total cost of a line item in a transaction (including taxes, fees, etc.).	decimal(18, 2)	x	x	
ExtendedPrice	Extended price of a line item in a transaction: Quantity * UnitPrice. This value represents the item price before any discounts or adjustments.	decimal(18, 2)	x	x	
TotalExcluding Tax	Total amount including tax	decimal(18, 2)	x	x	
TotalDryItems	Total number of dry items	int	x	x	
TotalChillerItems	Total number of chiller items	int	x	x	

Fact Purchase



Table 11: Transactional and master data for Fact Purchase

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
PurchaseKey	DW key for a row in the Purchase fact	int			
Datekey	Purchase order date	date	x		
SupplierKey	Supplier for this purchase order	int	x		
StockItemKey	Stock item for this purchase order	int	x		
LastReceiptDate	The date of the most recent receipt of stock from the supplier for this product.	date	x		x
SupplierReference	A unique identifier for the supplier of this product.	nvarchar(20)	x	x	
OrderedOuters	Quantity of outers (ordering packages)	int	x	x	
ReceivedOuter	Received outers (so far)	int	x	x	
Is Order Finalized	Is this purchase order now	bit	x	x	

	finalized?				
ExpectedUnitPrice PerOuter	Expected unit price for each outer (package or container) of the	decimal(18, 2)	x	x	

	product as specified in the order.				
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Fact Warehouse

*Table 12: Transactional and master data for Fact Warehouse*

Field Name	Descriptive	Type	Null	Master Data	Transaction Data
StockHolding Key	DW key for a row in the Stock Holding fact	int			
DateKey	Date for this invoice	date	x		
StockItemKey	Stock item being held	int	x		
Transaction TypeKey	Foreign key referencing the Transaction Type dimension, indicating the type of transaction for the	int	x		

	stock item.				
CustomerKey	Foreign key referencing the Customer dimension, identifying the customer involved in the transaction.	int	x		
SupplierKey	Foreign key referencing the Supplier dimension, identifying the supplier involved in the transaction.	int	x		
StockItem TransactionID	Unique identifier for the stock item transaction.	int	x	x	

InvoiceID	Foreign key referencing the Invoice dimension, identifying the invoice associated with the transaction.	int	x	x	
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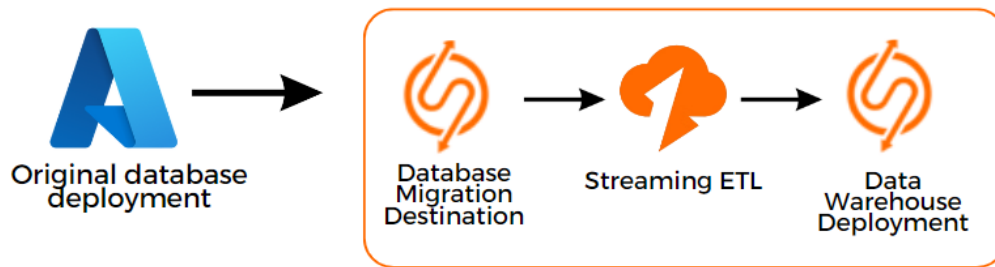
Purchase OrderID	Foreign key referencing the Purchase Order dimension, identifying the purchase order associated with the transaction.	int	x	x	
Quantity	The quantity of the stock item involved in the transaction. Positive values indicate an increase in stock, negative values indicate a decrease in stock.	decimal(18, 3)	x	x	

### 3.5. ETL Process

The goal of this section is to establish a robust Business Intelligence (BI) infrastructure that enables the migration of a database from Azure to Alibaba Cloud RDS, perform Extract, Transform, Load (ETL) processes using Streaming ETL from Alibaba Cloud's Data Transmission Service (DTS) to enable connection the transformed data to Power BI for visualization, which is our design Data Warehouse.

The workflow consists of 3 stages:

- Full database migration from Azure from Alibaba Cloud RDS via SSMS Export Import Tool.
- ETL with Alibaba Cloud DTS.
- Data Warehouse Deployment on Alibaba Cloud RDS.



### 3.5.1. Database Migration from Azure to Alibaba Cloud RDS

In the initial phase, the focus is on smoothly migrating the existing database from Azure to Alibaba Cloud RDS. This process involves utilizing SQL Server Management Studio's (SSMS) Export and Import tools. The following steps outline the migration process:

**Source Database Selection:** The migration starts with selecting the source database, which is the instance hosted on Azure. This database contains the data, schema, and any associated objects that need to be transferred.

- **Export from Azure Database:** Using the Export functionality in SSMS, the necessary database components are extracted from the Azure instance. This export creates a structured backup file that encapsulates the data and schema.

- **Alibaba Cloud RDS Setup:** A new instance of Alibaba Cloud RDS is created, serving as the target for the migration. Proper configurations and settings are established to align with the project's requirements.

- **Import to Alibaba Cloud RDS:** The previously exported backup file is imported into the newly established Alibaba Cloud RDS instance. The Import tool within SSMS facilitates this process, ensuring that the database structure and data are replicated on the RDS instance.

By successfully migrating the database from Azure to Alibaba Cloud RDS, the project ensures a seamless transition of critical data to the new environment, setting the foundation for subsequent ETL and visualization processes.

### 3.5.2. ETL Process

The ETL phase of the project is a critical step that involves the extraction, transformation, and loading of data from the source database to the data warehouse in Alibaba Cloud RDS. The ETL pipeline consists of several stages, each designed to ensure data quality, consistency, and readiness for analysis.

#### **3.5.2.1. Extract**

**Data Source Selection:** The ETL process starts by selecting the relevant tables and data from the source Azure database. This may involve identifying key tables, views, or specific data ranges based on business requirements.

**Change Data Capture (CDC):** To achieve real-time or near-real-time updates, Change Data Capture techniques are applied to capture only the incremental changes in the source data. This minimizes data transfer overhead and ensures data freshness.

#### **3.5.2.2. Transform**

**Data Cleansing:** Raw data from the source may contain inconsistencies, missing values, or errors. During the transformation stage, data is cleansed by removing or correcting inaccuracies. This involves handling outliers, null values, and formatting inconsistencies.

**Data Enrichment:** Additional data from external sources may be integrated to enhance the analytical value. For instance, appending geographical information or merging data from other systems can provide richer insights.

**Data Aggregation:** In the case of fact tables, data is often aggregated to appropriate levels for analysis. Aggregations could include sums, averages, counts, etc., based on the business requirements.

**Dimensional Modeling:** Dimension and fact tables are designed using a dimensional modeling approach such as the Star Schema or Snowflake Schema. This enables efficient querying and reporting by organizing data into meaningful hierarchies and relationships.

#### **3.5.2.3. Load**

**Staging Area:** Transformed data is first loaded into a staging area within the data

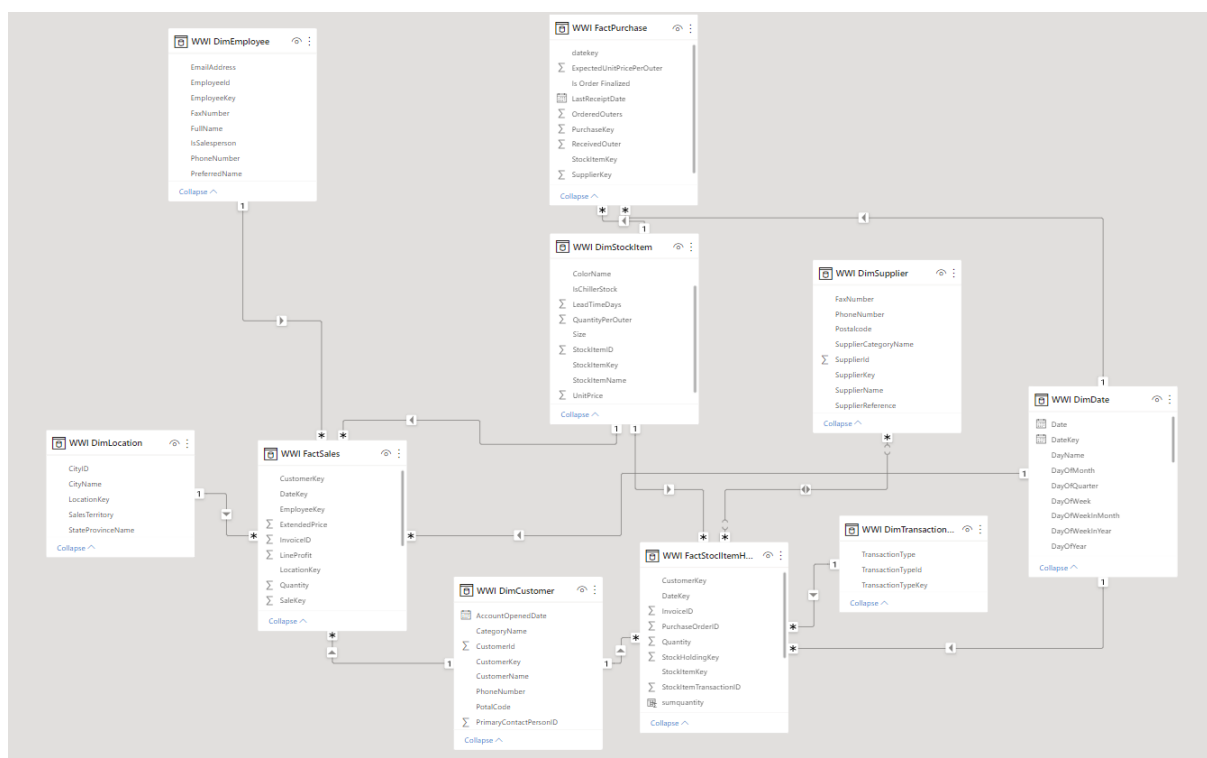
warehouse. This allows for validation and reconciliation before committing data to the final tables.

**Data Loading:** The validated data is then loaded into the appropriate dimension and fact tables within the data warehouse. This process may involve using INSERT, UPDATE, or MERGE operations to ensure data integrity.

**Indexes and Constraints:** Indexes and constraints are applied to the loaded data to optimize query performance and maintain data consistency.

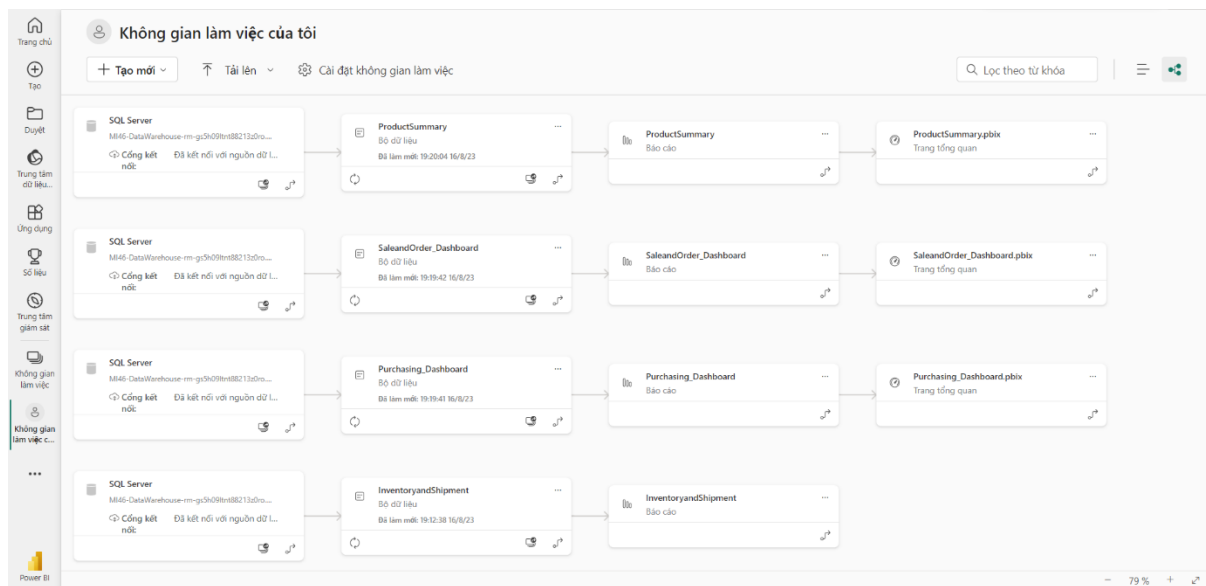
**Data Validation:** Post-loading, data is validated to ensure accuracy and completeness. This involves comparing counts, aggregations, and selected data points between the source and destination.

By meticulously designing and executing the ETL pipeline, the project ensures that the data warehouse is populated with accurate, consistent, and relevant data. This foundational step prepares the data for meaningful analysis and reporting using Power BI.



### 3.5.3. Data Warehouse Deployment

Once the data is available in the data warehouse, it's connected to Power BI for visualization and reporting. Instance can be accessed using SSMS.



## 3.6. Data Visualization

### 3.6.1. Sales Dashboard

In the field of sales, where data drives decisions and strategy, the Sales Dashboard plays the role of a compass guiding the business towards success. Let's explore the key performance indicators (KPIs) and corresponding charts to delve deeper into these sales efforts.

### 3.6.2. Order Trend Dashboard

Business is constantly evolving, and understanding KPIs deeply has the potential to shape decisions and strategies for each company. The dashboard, built on this data, will unearth customer ordering trends.

### 3.6.3. Product Summary

The Product Summary Dashboard delivers a dual perspective on product analytics, offering a Comprehensive Product Overview for holistic insights into individual product metrics and a focus on Trending Products to spotlight in-demand items. Tailored for product management and marketing teams, this tool enables agile decision-making, ensuring businesses stay attuned to market shifts and customer preferences.



#### **3.6.4. Inventory and Shipments Dashboard**

An inventory and shipment dashboard provides a visual overview of inventory levels and shipment processes. It helps monitor performance, track key metrics like turnover, order accuracy, and delivery times, and supports data-driven decisions. The dashboard optimizes inventory, ensures timely shipments, and enhances operational efficiency, leading to better supply chain management and customer satisfaction. This dashboard will show the warehouse department operations.

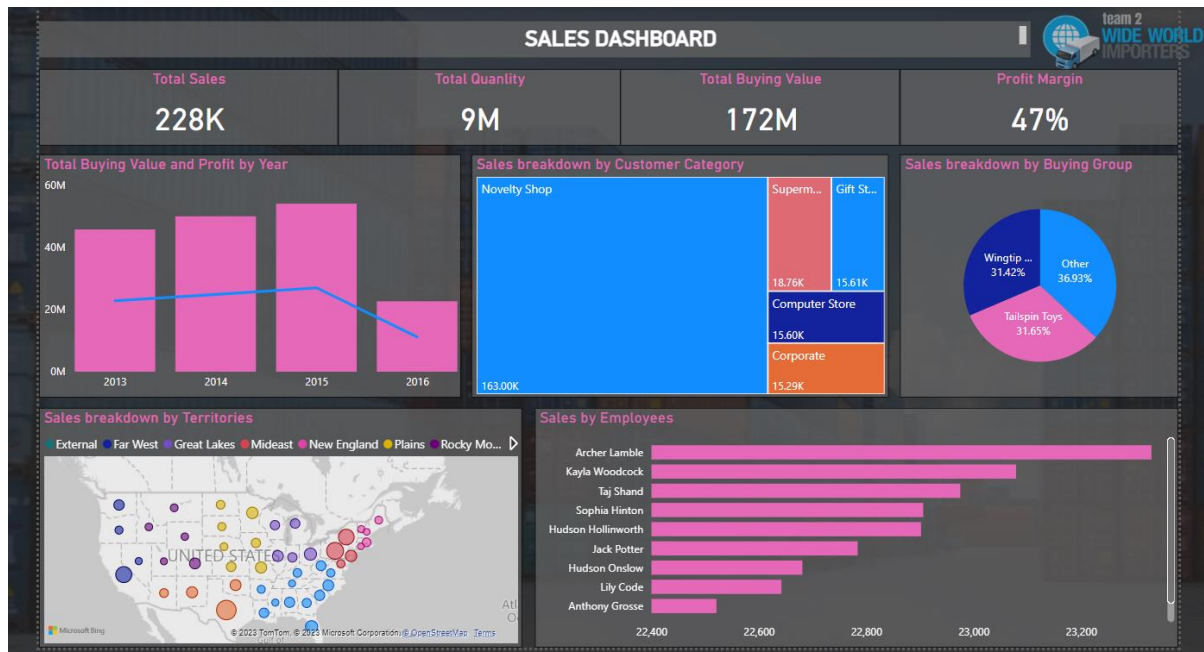
#### **3.6.5. Purchase and Transaction Dashboard**

In today's fast-paced business environment, effective purchasing management is pivotal to achieving operational efficiency and cost optimization. To facilitate informed decision-making, our organization has developed a comprehensive Purchasing Analysis Dashboard. This dashboard amalgamates critical procurement metrics, offering stakeholders a holistic view of purchasing activities, supplier performance, and expenditure trends. By harnessing the power of data visualization, our dashboard empowers businesses to enhance their procurement strategies, mitigate risks, and optimize resource allocation.

## CHAPTER 4: RESULTS – DATA ANALYTICS AND VISUALIZATION

### 4.1. Report and dashboard systems

#### 4.1.1. Sales Dashboard



##### 4.1.1.1. Total Sales Evolution

The company's strong sales strategies have resulted in significant total sales and profit. Starting the Sales story, the company has sold 228 thousand products, generating a total buying value of up to 172 million Vietnamese dong. With a profit margin of 47%, this indicates the company has strong strategies in place to achieve these figures.

##### 4.1.1.2. Total Buying Value and Profit by Year

The buying value and profit have shown fluctuations over the years, with a decline in 2016. Looking at the Column and Line chart, it illustrates the variation of Buying Value over each year in the business operation. The columns and lines are alternated, depicting the relationship between buying value and profit, narrating the story of the business trend increasing from 2013 to 2015 and experiencing a decline in 2016.

##### 4.1.1.3. Sales Breakdown by Customer Category

Customer groups vary in revenue contribution, highlighting the need for tailored strategies. Entering the "Customer Category" section, the data presents information about customer groups. Larger blocks represent customer groups with higher revenue, emphasizing their significance. In this chart, we gain an overview of the diversity among customer groups,

enabling us to formulate strategic plans.

#### 4.1.1.4. Sales Breakdown by Buying Group

Sales volume varies among buying groups, indicating opportunities for partnership growth. This chart offers insight into the distribution of sales volume among different buying groups, aiding our understanding of the business activities of partners. Simultaneously, it informs us about the steps needed to build relationships with partners for maximum profitability.

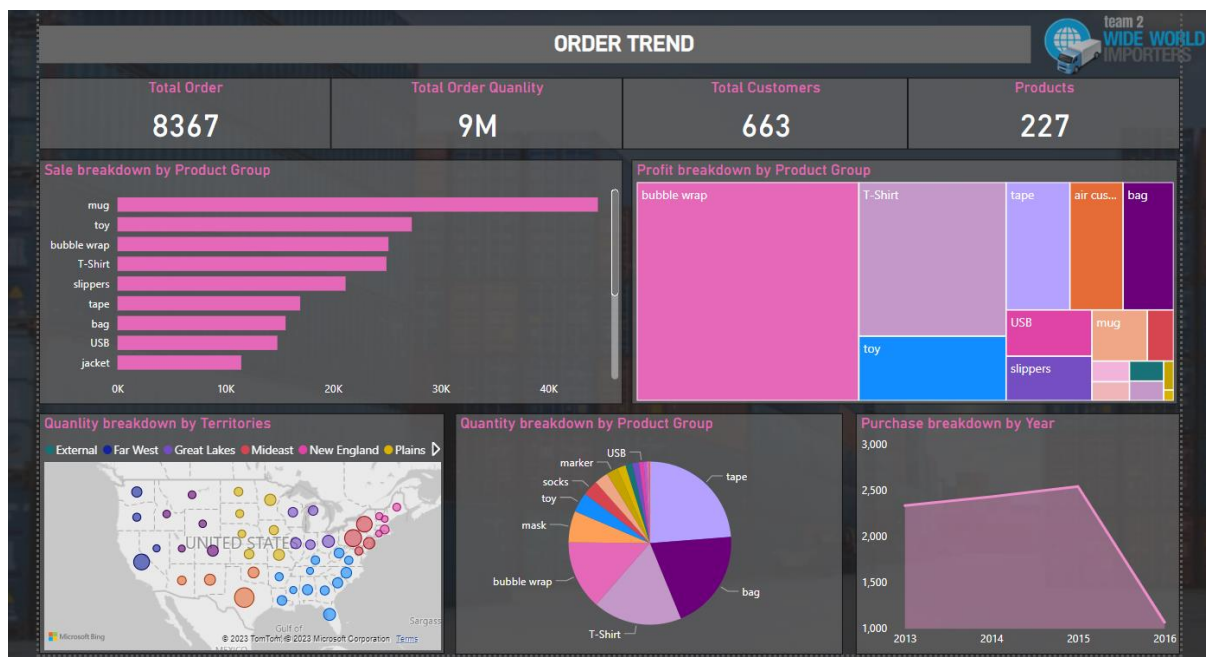
#### 4.1.1.5. Sales Breakdown by Buying Group: Wingtip, Tailspin, and Other

Focus on areas with the best performance and growth potential. This chart allows us to focus on areas with the best performance and nurture those with growth potential.

#### 4.1.1.6. Sales by Employee

Employee contributions vary; recognizing and rewarding their efforts is crucial. Behind the Sales narrative, we must understand the contributions and efforts of our employees. The Sales by Employee chart reflects their contributions, with each bar representing their individual efforts. This provides us with a rational approach to recognize their hard work and dedication.

### 4.1.2. Order Trend



#### ***4.1.2.1 Total Orders Evolution***

Recent dynamic activities with a diverse customer base and product portfolio. During the recent period, vibrant buying and selling activities have taken place, with a total of 8,367 orders placed, involving a substantial quantity of 9 million units of goods. Additionally, there's engagement from 663 distinct customers, showcasing a broader customer base, and the diverse product portfolio comprises 227 different items. These figures paint an overall picture of the scale and scope of business operations over the given timeframe.

#### ***4.1.2.2. Sales Breakdown by Product Group***

Some product groups contribute more to revenue. This column chart analyzes sales figures according to product groups. This helps identify which product groups contribute more to revenue compared to others. It enables the shaping of subsequent strategies for each product group, whether it's about increasing, decreasing, or discontinuing.

#### ***4.1.2.3. Profit Breakdown by Product Group***

Profit distribution across product groups varies. The Treemap chart analyzes profit distribution across product groups. It allows us to perceive the most noteworthy aspects of profit allocation among different product groups.

#### ***4.1.2.4. Quantity Breakdown by Territories***

Geographical demand variation indicates optimization opportunities. Analyzing the quantity of goods sold across different geographical territories. This index assists in identifying which areas are experiencing strong demand and where optimization is required.

#### ***4.1.2.5. Quantity Breakdown by Product Group***

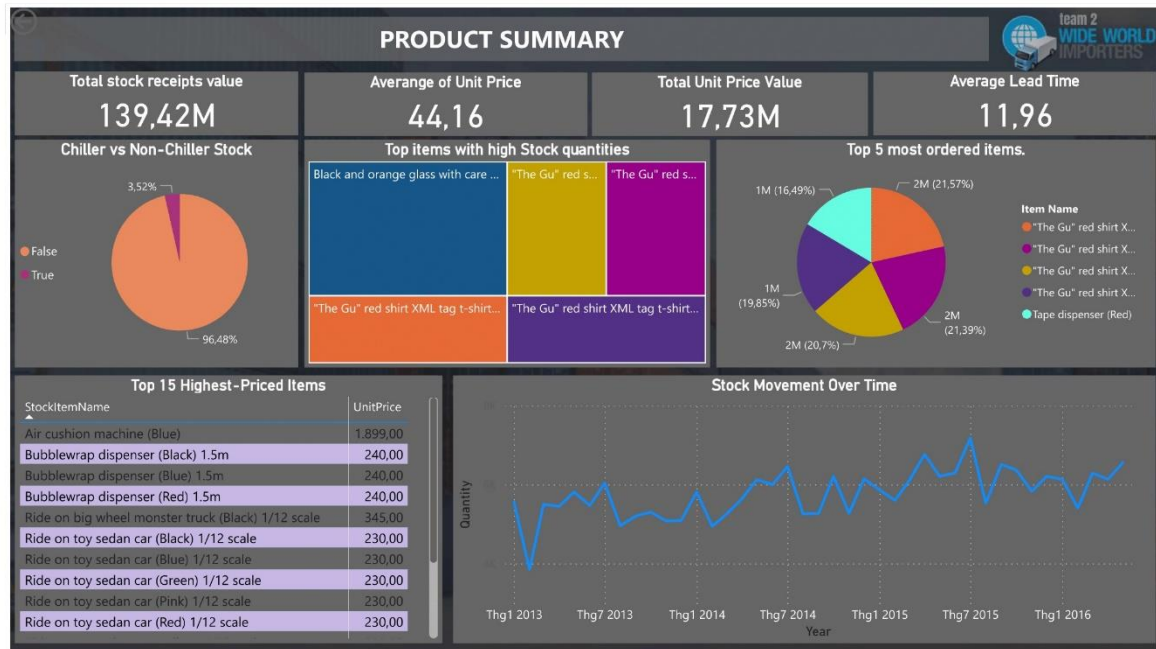
Some product groups hold greater significance. This pie chart analyzes the percentage distribution of the quantity of goods sold for each product group. It illustrates the allocation of goods based on which product categories hold the utmost significance within the market.

#### ***4.1.1.6. Purchase Breakdown by Year***

Shopping trends over time impact the business situation. This area chart analyzes the purchase distribution across years. This aids in recognizing shopping trends over time and understanding the current business situation. By leveraging these insights, the Sales and Order

Trend Dashboards can guide the company's decision-making, helping to optimize sales strategies, customer engagement, and product offerings for sustained growth and success.

### 4.1.3. Product Summary



#### 4.1.3.1. Numeric Insight visual by Card

**Total Stock Receipt Value:** Instantly know the aggregate value of all stock received, pivotal for grasping our inventory's fiscal significance.

**Average Unit Price:** Understand the mean price across our stock, helping pinpoint the majority of our items' pricing context.

**Total Unit Price Value:** Gauge potential revenue by viewing the collective value of each stock item at its unit price.

**Average Lead Time:** Track the average duration from order placement to receipt, crucial for refining procurement strategies.

#### 4.1.3.2. Chart

A table showcases the Top 15 Priced Items, emphasizing our inventory's premium segment. The adjacent matrix reveals items with the Highest Stock Quantities, highlighting

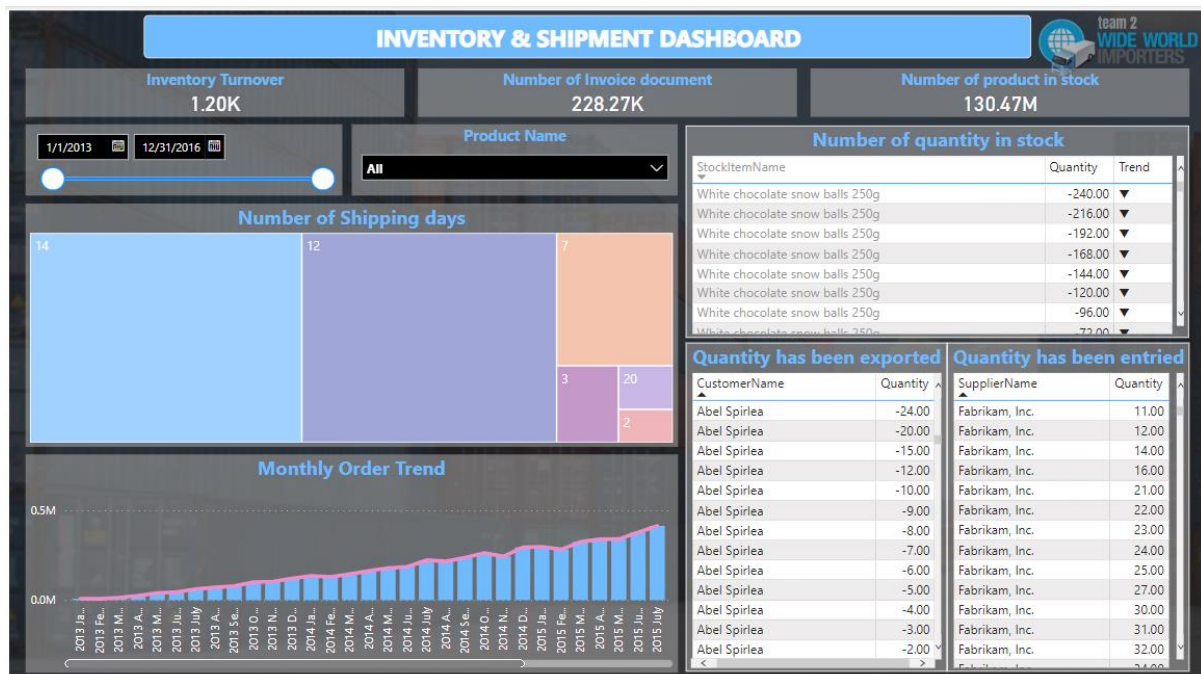
products either high in demand or potentially overstocked.

Two distinct pie charts follow:

- Chiller vs. Non-Chiller Stock: Discern inventory based on storage requirements, facilitating better logistics management.
- Top 5 Most Ordered Items: Decode consumer preferences, providing a snapshot of market trends.

Concluding the dashboard, a line chart visualizes Stock Movement Over Time. The trend lines help predict demand surges and slowdowns, guiding procurement and sales approaches. In essence, the Product Summary Dashboard goes beyond just presenting numbers and graphs. It embodies the core of product and item insights. Crafted to spotlight the broader story of product portfolio, it paves the way for informed decision-making. Dive deep into its insights and harness the power of nuanced product understanding.

#### 4.1.4. Inventory and Shipment Dashboard



Inventory and Shipment Dashboard can benefit from using data to identify trends and opportunities for improvement. By analyzing key metrics with Microsoft Power BI, warehouse managers can make informed decisions to optimize warehouse operations and improve

performance. Some of the key metrics that can be tracked and visualized with Power BI include:

**Inventory turnover:** measures how often inventory is sold and replaced over a period of time. This metric helps warehouse managers understand how efficiently inventory is moving through the warehouse and identify potential areas for improvement such as reducing excess inventory or improving order fulfillment times.

**Number of Products in Stock:** displays the count of distinct product items currently available in the warehouse or inventory. This metric provides a straightforward view of how many different types of products are on hand at a given point in time. It's a key indicator for inventory management, allowing businesses to understand their product diversity and availability for sales, order fulfillment, and overall operational planning.

**Number of Invoice Documents:** indicates the count of invoices that have been generated within a specific timeframe. This metric helps track the volume of sales transactions and provides insights into revenue generation. It's valuable for monitoring sales performance, analyzing customer buying behavior, and assessing the overall health of the business.

**Shipping time:** measures how long it takes to fulfill and ship orders to customers. By tracking shipping time with Power BI, warehouse managers can identify areas for improvement such as reducing order processing times, optimizing warehouse layout, and improving logistics.

**Monthly order trend:** shows the patterns and performance of orders over each month. This visual provides insights into how order volumes fluctuate throughout the year and helps monitor the warehouse's operational efficiency and demand patterns. It's a valuable tool for understanding monthly trends, identifying peak periods, and optimizing inventory management and staffing.

**Number of Quantity in Stock:** provides a snapshot of the current inventory levels for various products. It displays the quantity of each product available in the warehouse at a given point in time. This metric is crucial for inventory management, helping businesses avoid stockouts and overstock situations, and ensuring optimal stock levels for efficient operations.

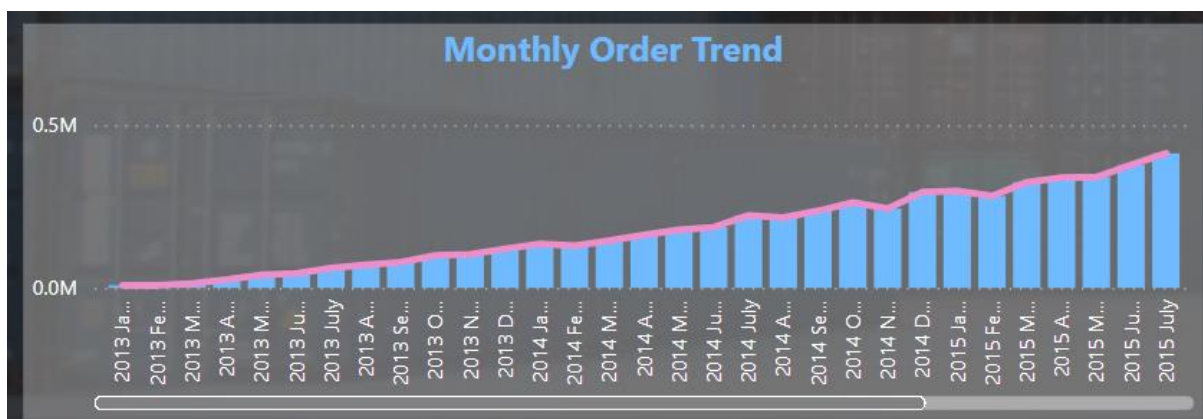


and customer satisfaction.

**Quantity Exported and Entried:** track the flow of goods in and out of the warehouse. It shows the amount of items that have been exported or shipped out of the warehouse as well as the amount that have been entered or received into the warehouse. This information helps in managing inventory accuracy, monitoring order fulfillment, and ensuring the balance between outbound and inbound operations for effective supply chain management.

#### ***4.1.4.1. Monthly Order Trend***

In the dynamic world of supply chain management, staying informed and responsive is crucial. Our inventory and shipment dashboard provides a panoramic view of key metrics that drive our warehouse operations, helping us make data-driven decisions to optimize efficiency, meet customer demands, and enhance profitability. Let's embark on a storytelling journey through the metrics that guide our supply chain performance.



As we delve into our dashboard, the "Monthly Order Trend Metrics" paint a vivid picture of order dynamics throughout the year. The peaks and valleys in this visual narrative reflect the ebb and flow of customer demand, providing insights into seasonal trends and highlighting periods of heightened activity. By understanding these patterns, we can better allocate resources, manage inventory, and ensure timely order fulfillment during peak months.

#### ***4.1.4.2. Number of Quantity in Stock***



Number of quantity in stock		
StockItemName	Quantity	Trend
White chocolate snow balls 250g	-240.00	▼
White chocolate snow balls 250g	-216.00	▼
White chocolate snow balls 250g	-192.00	▼
White chocolate snow balls 250g	-168.00	▼
White chocolate snow balls 250g	-144.00	▼
White chocolate snow balls 250g	-120.00	▼
White chocolate snow balls 250g	-96.00	▼
White chocolate snow balls 250g	-72.00	▼

This snapshot reveals the heartbeat of our inventory, showcasing the availability of various products in our warehouse. A glance at this metric enables us to strike the delicate balance between avoiding stockouts and preventing overstock situations. With this insight, we ensure that our shelves are stocked just right, optimizing operational efficiency while meeting customer expectations.

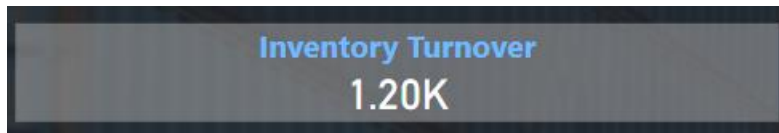
#### 4.1.4.3. *Quantity has been exported/entried*

Quantity has been exported		Quantity has been entried	
CustomerName	Quantity	SupplierName	Quantity
	-1.00	Fabrikam, Inc.	6.00
Aakriti Byrraju	-1.00	Fabrikam, Inc.	7.00
Abel Spirlea	-1.00	Litware, Inc.	7.00
Abel Tatarescu	-1.00	Fabrikam, Inc.	8.00
Abhra Ganguly	-1.00	Fabrikam, Inc.	9.00
Adrian Andreasson	-1.00	Litware, Inc.	9.00
Adriana Pena	-1.00	Fabrikam, Inc.	10.00
Agrita Abele	-1.00	Litware, Inc.	10.00
Agrita Kanepa	-1.00	Fabrikam, Inc.	11.00
Aishwarya Dantuluri	-1.00	Litware, Inc.	11.00
Aive Petrov	-1.00	Fabrikam, Inc.	12.00
Ajitaab Pakalapati	-1.00	Litware, Inc.	13.00
Akhil Nadar	-1.00	Fabrikam, Inc.	14.00

Continues with the "Quantity Exported and Entered Metrics." Here, we witness the rhythmic dance of goods flowing in and out of our warehouse. This metric captures the harmony between outbound shipments and inbound receipts, revealing the synergy that powers

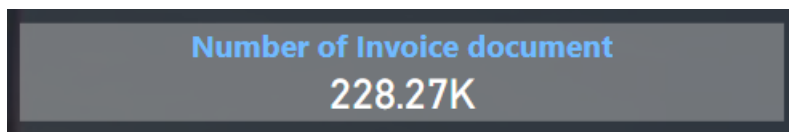
our supply chain. By maintaining this equilibrium, we ensure that orders are fulfilled promptly, and our inventory remains accurate, supporting the overall health of our operations.

#### ***4.1.4.4. Inventory Turnover***



This chapter chronicles the efficiency of our inventory management practices. A high turnover rate signals agility and smart inventory management, while a low rate raises a flag for potential improvements. This metric's storyline guides us in optimizing stock levels, reducing costs, and maximizing our operational efficiency. In this case, the inventory turnover equals to 1200 which means that every 1200 days, the company out of stocks and need to import new products from suppliers.

#### ***4.1.4.5. Number of Invoice documents***



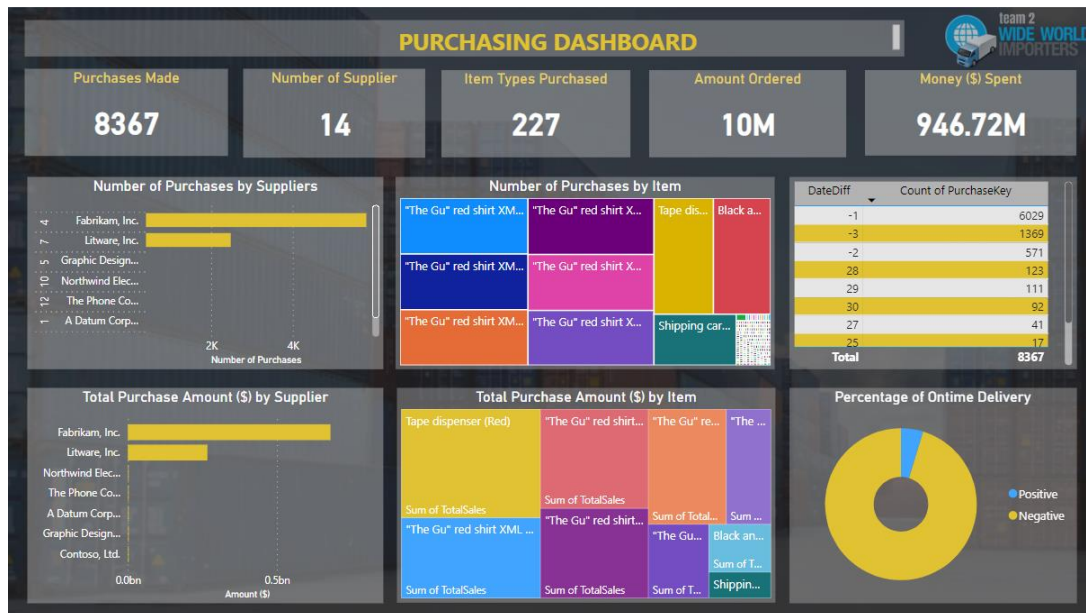
Finally, our journey concludes with the "Number of Invoice Documents." This metric narrates the tale of revenue generation, providing an account of completed sales transactions. Each invoice represents a piece of the puzzle contributing to our financial success. By tracking this count, we gain insights into sales trends, customer preferences, and the overall health of our business.

As we close the chapter on our dashboard journey, we recognize the power of data-driven storytelling in supply chain management. Each metric we explored contributes to a comprehensive narrative, guiding our decisions and actions to drive operational excellence. With this dashboard as our guide, we navigate the dynamic landscape of supply chain management with confidence, leveraging insights to shape a successful future.

#### **4.1.5. Purchase and Transaction Dashboard**

The final dashboard is Purchasing Dashboard, which showcases the details about

purchasing activities. The Purchasing Analysis Dashboard is a designed to provide comprehensive insights into your company's procurement activities. By visualizing key purchasing metrics and performance indicators, this dashboard offers a clear overview of your procurement operations, enabling better decision-making, improved supplier relationships, and cost optimization.



The dashboard covered several metrics and details which will be explained in the following subsections.

#### 4.1.5.1. Numeric insights (visualized by cards)

On the top section of the dashboard, 5 cards are used to visualize these information:  
Purchases Made: the number of Purchased Order was made by the enterprise. This is done by counting the number of Supplier Key.

Number of Supplier: the number of suppliers participated in purchasing history, which means the providers of products purchased.

Item Types Purchased: The number of item type (product name) was purchased. This is done by simply counting the number of stock item keys.

Amount Ordered: the amount of products ordered. This is calculated by summing all the amount of all purchases.

Money Spent: the actual money spent for purchasing.

#### **4.1.5.2. Charts**

Performance by Supplier: Supplier relationships play a pivotal role in maintaining a resilient supply chain. The dashboard provides an overview of supplier performance, including metrics such as on-time delivery, product quality, and order accuracy. This data helps procurement managers identify top-performing suppliers and areas for improvement.

Expenditure Breakdown by Supplier and Product: Understanding expenditure distribution across suppliers and products is essential for strategic decision-making. Our dashboard offers a visual breakdown of how much money is spent with each supplier and on each product. This insight aids in negotiating favorable terms with high-spend suppliers and optimizing product-specific procurement strategies.

Supplier Comparison: To further aid supplier evaluation, the dashboard provides a comparative analysis of different suppliers' performance metrics. This enables procurement professionals to make data-driven decisions when choosing between multiple suppliers, ensuring the selection of partners aligned with organizational goals.

Product Type Analysis: A key aspect of procurement analysis is assessing the variety of product types purchased. The dashboard provides an overview of the number of product types bought, helping identify trends and enabling proactive inventory management strategies.

Product Type Expenditure: Knowing the amount of money spent on various product types is integral for resource allocation. Our dashboard visualizes expenditure patterns across different product categories, facilitating budgeting and forecasting exercises.

## **4.2 Evaluation and Discussion**

### **4.2.1. Evaluation of the Implementation Strategy**

The project's primary objective was to implement a data warehouse for Wide World Importers (WWI) to facilitate data-driven decisions. The rationale behind this strategy seems well-founded, given WWI's position as a global import and export company. The decision to

centralize data into a single source of truth is commendable, as this would allow for consistent and accurate data retrieval, crucial for businesses with extensive operations.

#### **4.2.2. Analysis of the Results**

The project's results, mainly in the form of dashboards and visualizations, indicate a comprehensive approach to data representation. For instance, the Sales Dashboard provides insights not just into the total sales evolution but also into more nuanced metrics like buying value and profit trends. Such detailed insights can be pivotal in strategizing business operations.

However, one could argue that the success of such implementations is determined by their actionable insights. It would be beneficial to understand how these visualizations have directly influenced business decisions or identified areas of improvement.

#### **4.2.3. Use of Tools and Technologies**

The choice of tools such as Alibaba Cloud for ETL processes, SQL for data storage, and Power BI for visualization seems apt for a project of this nature. Power BI, being a leading tool in data visualization, would undoubtedly provide a user-friendly interface and comprehensive visualization options. The integration of these tools indicates a seamless flow from data extraction to representation.

#### **4.2.4. Concluding Remarks**

While the project has successfully achieved its primary objective of implementing the data warehouse, the real test lies in its practical application. How WWI integrates these insights into their business strategy, and the subsequent impact on their performance, would be the real metric of success.

Additionally, it's crucial to address any limitations highlighted in the report and ensure they don't impede the practical application of the project's outputs. Future works or iterations of this project could delve deeper into predictive analytics or machine learning to further enhance the data-driven decision-making process.

Lastly, the absence of a detailed methodology section and literature review in the provided content makes it challenging to understand the theoretical foundation and the

approach taken during the implementation. Including these sections in future reports would give a more holistic view of the project, aiding both in its evaluation and in drawing parallels with other similar projects in the field.

## **CHAPTER 5. CONCLUSION & FUTURE WORKS**

### **5.1. Conclusion**

In summation, the Sales Dashboard serves as an indispensable tool, offering a comprehensive overview of the company's sales strategies and their tangible outcomes. The section on Total Sales Evolution encapsulates a narrative of success, shedding light on the company's adeptness in product sales and its consequent revenue generation. The examination of Total Buying Value and Profit by Year delves into the cyclic nature of business, emphasizing both periods of growth and declines. These observations hold vital implications for strategic decision-making, providing nuanced insights into the dynamics of the market.

Equally noteworthy is the Sales Breakdown by Customer Category and Buying Group section, which underscores the need for tailored approaches in catering to diverse customer segments and procurement partners. These granular insights offer the company an avenue to adapt its strategies, fostering more robust relationships and optimizing profitability. By focusing on distinct buying groups, such as Wingtip, Tailspin, and Others, targeted growth strategies can be executed with precision.

Human contributions are recognized through the Sales by Employee chart, acknowledging the vital role employees play in the company's success. By highlighting individual and collective efforts, this chart emphasizes the significance of employee recognition, thereby potentially enhancing motivation and commitment, resulting in improved sales performance.

Transitioning to the Order Trend section, the Total Orders Evolution provides a window into the company's engagement with customers and its wide-ranging product portfolio. The analysis of Sales Breakdown by Product Group and Profit Breakdown by Product Group delves into the intricate dynamics of product performance, aiding strategic decisions pertaining to product management and optimization.

Geographical insights are illuminated through Quantity Breakdown by Territories, which facilitates efficient supply chain and distribution strategies. Concurrently, the Quantity Breakdown by Product Group offers a snapshot of market demands, enabling the company to tailor its offerings in accordance with prevailing market trends.

The Product Summary Dashboard transcends mere numerical data, offering deeper insights into the company's product portfolio. It offers a holistic comprehension of stock valuation, pricing strategies, and customer preferences, thereby guiding informed decision-making processes. The Inventory and Shipment Dashboard leverages data-driven insights to enhance warehouse management, inventory turnover, and order fulfillment efficiency, underscoring the company's commitment to operational excellence.

Concluding the insights, the Purchase and Transaction Dashboard brings the procurement process to the forefront. By visually presenting key metrics and supplier performance indicators, this section optimizes procurement operations and cultivates robust supplier relationships. This comprehensive approach ensures a resilient supply chain and cost-effectiveness.

In essence, these dashboards collectively empower the company to navigate the complexities of business operations through data-backed insights. By harnessing these insights, the company can formulate well-informed strategies, streamline efficiency, bolster customer engagement, and drive sustainable growth. The visual narrative approach embedded within these dashboards transforms raw data into actionable insights, effectively facilitating decision-making processes across all facets of the business. As the company continues its journey, these dashboards stand as indispensable assets in its pursuit of operational excellence.

## **5.2. Limitations**

However, the project encountered its fair share of challenges. The geographical dispersion of team members led to connectivity issues and database linkage problems, hampering seamless collaboration and data integration at times.

Additionally, the project faced difficulties due to the diverse array of devices used by team members. Exporting data from SQL into Tableau, preferred by some, proved to be problematic. As a result, the collective decision was made to switch to Power BI for its compatibility and streamlined data integration. This transition was a strategic move that ensured smoother data handling across various devices.



In retrospect, these challenges acted as catalysts for innovation and adaptation. The geographical divide prompted new communication strategies, and the device diversity led to a deeper exploration of data integration techniques. These challenges, rather than derailing the project, spurred the team to enhance collaboration and embrace flexibility. They underscored the dynamic nature of data projects and the importance of finding optimal solutions to drive successful outcomes.

### **5.3. Future Works**

Looking ahead, there are several potential avenues for further development and enhancement in the field of data visualization. One immediate future direction involves exploring visualizations using Tableau, providing an opportunity to compare and contrast the capabilities of different visualization tools. This could potentially reveal unique insights and visualization techniques not yet explored.

Moreover, the project could be extended to create more refined and aesthetically pleasing dashboards with a focus on enhancing user experience and accessibility. This includes incorporating advanced interactivity, filters, and user-friendly features to empower stakeholders to easily extract insights from the data.



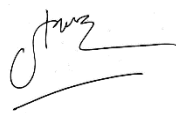

Furthermore, the exploration of additional KPIs and metrics could provide a comprehensive overview of the business landscape. By continuously refining and expanding the visualizations, the project could contribute significantly to data-driven decision-making processes, ultimately driving the company's success in the dynamic market environment.

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## APPENDIX

### PROJECT MEMBER EVALUATION (Signed by all members)

Member	MSSV	Evaluation	Signature
Đào Phương Anh	K204160660	100%	
Võ Thị Phương Anh	K204071522	100%	
Bùi Thị Tri Tâm	K204161999	100%	
Lê Minh Trí	K204162004	100%	

Link to our dashboard which are published on power bi:

[1] Sales and Order Dashboard: [https://app.powerbi.com/links/01kXVobFsF?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi\\_source=linkShare](https://app.powerbi.com/links/01kXVobFsF?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi_source=linkShare)

[2] Product Summary Dashboard: [https://app.powerbi.com/links/nhjXXasgdj?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi\\_source=linkShare](https://app.powerbi.com/links/nhjXXasgdj?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi_source=linkShare)

[3] Inventory and Shipment Dashboard: [https://app.powerbi.com/links/OIJFq7HN44?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi\\_source=linkShare](https://app.powerbi.com/links/OIJFq7HN44?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi_source=linkShare)

[4] Purchasing Dashboard: [https://app.powerbi.com/links/hIoOHYVhfn?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi\\_source=linkShare](https://app.powerbi.com/links/hIoOHYVhfn?ctid=07acb355-56bc-489b-b98c-8fea440460e8&pbi_source=linkShare)