Data Driven in Supply Chain Management

Problem Understanding

Supply chain management is a critical aspect of modern businesses, involving the coordination of various processes and activities to ensure the efficient flow of goods and services from suppliers to customers. However, traditional supply chain management approaches often rely on manual processes, historical data, and intuition, leading to inefficiencies, delays, and suboptimal decision-making. The business problem addressed in this project is the need for data-driven innovations that can streamline supply chain operations, enhance decision-making, and improve overall supply chain performance.

Business Requirements

1. Develop a data-driven framework for supply chain management that leverages advanced analytics techniques.
2. Implement predictive models to forecast demand, optimize inventory levels, and minimize stock outs or overstocking.
3. Develop algorithms for route optimization and transportation planning to minimize transportation costs and delivery times.
4. Implement real-time monitoring and tracking systems to gain visibility into the supply chain and identify potential disruptions or bottlenecks.
5. Develop decision support systems to aid in strategic sourcing, supplier selection, and contract negotiation processes.
6. Integrate data from various sources, such as IoT sensors, RFID tags, and enterprise resource planning (ERP) systems, to enable end-to-end supply chain visibility and optimization.
7. Ensure data security, privacy, and compliance with relevant regulations.
8. Provide user-friendly dashboards and reporting tools for supply chain stakeholders to access and analyse relevant data.

Literature Survey

S.NO	Title of the paper published	Description	Advantages	Disadvantages
1	Machine Learning for Supply Chain Management: A Review and Applications" by Nguyen et al. (2022)	Comprehensive review of machine learning techniques applied to various supply chain problems, including demand forecasting, inventory optimization, and route planning.	Highlights potential benefits of using machine learning for improved efficiency and decision-making.	Lacks specific algorithm details and implementation considerations.
2	Big Data Analytics in Supply Chain Management: A Systematic Review and Opportunities for Future Research" by Nguyen et al. (2022)	Comprehensive review of big data analytics applications in supply chain management, including demand forecasting, inventory optimization, and supplier selection.	Highlights the benefits of leveraging large-scale data sources for decision-making in supply chains.	Limited discussion on challenges of integrating and processing heterogeneous data sources in supply chains.
3	Predictive Analytics in Supply Chain Management: A Systematic Review and Future Research Directions" by Srinivasan and Dey (2021)	Focuses on applications of predictive analytics techniques, such as machine learning and time series forecasting, in supply chain management. Identifies key challenges and future research directions.	Highlights the potential benefits of predictive analytics for supply chain optimization.	Limited coverage of recent developments in deep learning and advanced neural network architectures for supply chain problems.

Social Impact

1. **Environmental Sustainability:** Data-driven optimization of transportation routes, inventory management, and resource utilization can lead to reduced carbon emissions and a smaller environmental footprint for supply chain operations.
2. **Improved Product Availability and Affordability:** Efficient supply chain management enabled by data-driven approaches can ensure better product availability and lower costs, benefiting consumers with access to affordable goods.
3. **Job Creation and Skill Development:** The implementation of data-driven supply chain management may require new roles and skill sets, leading to job opportunities in data analytics, machine learning, and supply chain optimization, contributing to economic growth and skill development.
4. **Ethical and Responsible Sourcing:** Data-driven supply chain innovations can enhance transparency and traceability, enabling businesses to ensure ethical and responsible sourcing practices, fair labour conditions, and adherence to social and environmental standards.
5. **Disaster and Crisis Preparedness:** Real-time monitoring and predictive analytics can help identify and mitigate potential supply chain disruptions, enhancing resilience and preparedness for natural disasters, health crises, or other emergencies.

Business Impact

1. **Cost Savings and Operational Efficiency**: Data-driven optimization of processes, inventory management, and transportation can lead to significant cost savings and improved operational efficiency for businesses.
2. **Competitive Advantage:** Companies that adopt data-driven supply chain innovations can gain a competitive edge by improving agility, responsiveness, and decision-making capabilities, enabling them to meet customer demands more effectively.

3. **Enhanced Customer Satisfaction:** Accurate demand forecasting, efficient order fulfilment, and real-time tracking enabled by data-driven approaches can lead to improved customer experiences and higher satisfaction levels.
4. **Risk Mitigation and Supply Chain Resilience:** Real-time monitoring, predictive analytics, and data-driven decision support systems can help identify and mitigate potential supply chain risks, enhancing the resilience and risk management capabilities of businesses.
5. **Data-Driven Insights and Decision-Making:** Access to real-time data and advanced analytics can provide businesses with valuable insights and support data-driven decision-making processes, leading to more informed and effective supply chain strategies.

Data Collection & Extraction From Database

Collecting data means gathering information that is needed for analysis. This involves measuring and recording details about the topics or variables of interest in a systematic way. Proper data collection allows researchers to answer their questions, test ideas, evaluate results, and discover new insights from the data.

The dataset for this project was downloaded from Kaggle (kaggle.com), a website that provides many publicly available datasets. Specifically, the "Dataco Smart Supply Chain for Big Data Analysis" dataset, available at https://www.kaggle.com/datasets/shashwatwork/dataco-smartsupply-chain-for-big-data-analysis/data ,was used.

In simple terms, data was first collected from various sources and compiled into a dataset. This dataset was then made publicly available on Kaggle at the link provided. For this project, the relevant dataset was downloaded from the specified link on Kaggle so it could be extracted and analysed to understand supply chain processes better.

Understand the Data

Data contains all the Meta information regarding the columns described in the CSV files

Column Description of the Dataset:

- Type: Type Count
- Days for shipping (real): Product shipment days
- Days for shipment (scheduled): product getting prepared for shipment
- Benefit per item: profit earned per product
- Sales per customer: No of products purchased by the customer
- Delivery: Products delivery date.
- Late_delivery_risk: percentage of late delivery risk
- Category Id: product category ID
- Category: product category
- Customer City: Customer purchase city
- Customer Country: Customer purchase country
- Customer Email: Customer purchase Email
- Customer Fname: Customer First name.
- Customer ID: Customer order ID
- Customer Lname: Customer's last name

- Order City: Customer purchase city
- Order Country: Customer purchase country
- Order Customer ID: Customer
- order date (Date Orders): Customer order date
- Order Item Product Price: product price
- Order Item Profit Ratio: profit ratio
- Order Item Quantity: No of orders placed
- Sales: total no of sales
- Order Item Total: total price of the order placed
- Order Profit Per: product
- Order Region: order placed region
- Order State: order placed State
- Order Status: order delivery status
- Order Zip code: customer area code
- Product Card ID: product number
- Product Category Id: a product whose category belongs to
- Product: what product
- Product Image: image of the product
- Product Price: Price of the product.

Data Preparation

Before data can be effectively visualised, it often needs to be preprocessed and transformed into a suitable format. This step, known as data preparation or data wrangling, is crucial for ensuring that the visualisations are accurate, insightful, and easy to interpret.

The process of preparing data for visualisation typically involves several steps:

1. **Data cleaning:** Removing or handling missing values, duplicates, errors, and inconsistencies in the data.
2. **Data transformation:** Converting data into a format that is suitable for visualisation, such as reshaping data from wide to long format, or vice versa.
3. **Data aggregation:** Grouping or summarising data based on specific variables or categories to create meaningful aggregates for visualisation.
4. **Feature engineering:** Creating new features or variables from existing ones that may provide better insights or enable more effective visualisations.
5. **Data sub setting:** Selecting relevant subsets of the data based on specific criteria or filters to focus the visualisations on areas of interest.
6. **Data formatting:** Ensuring that data types (e.g., numerical, categorical, date/time) are correctly formatted for the chosen visualisation techniques.

By preparing the data properly, visualisations can accurately represent the underlying data, reveal patterns and trends more effectively, and support better decision-making based on the insights derived from the visualisations.

Data Visualization

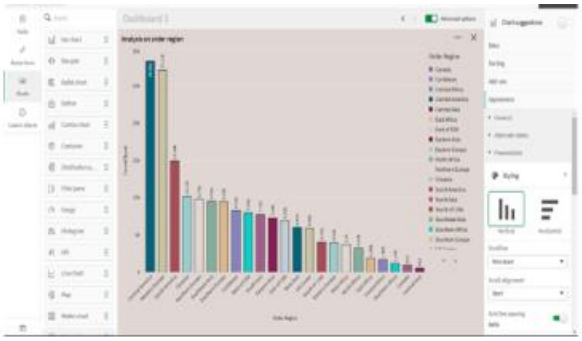
Data visualisation is the process of creating graphical representations of data to help make complex datasets more accessible, intuitive, and easier to interpret. It involves transforming numbers, text, and raw data into visuals like charts, graphs, maps, and other visual elements. The goal is to leverage these visuals to represent information in a way that allows people to quickly identify patterns, trends, outliers, and key insights within the data. Effective data visualisations enable stakeholders to grasp crucial information at a glance, something that is often challenging with raw data alone. By presenting data visually, it becomes more comprehensible, even for those without extensive statistical or analytical expertise. Clear and compelling data visualisations act as a universal language for communicating data-driven insights to diverse audiences, enhancing communication and supporting better decision-making based on the insights derived from the visuals. Ultimately, data visualisation plays a crucial role in making complex datasets more accessible, understandable, and actionable, driving

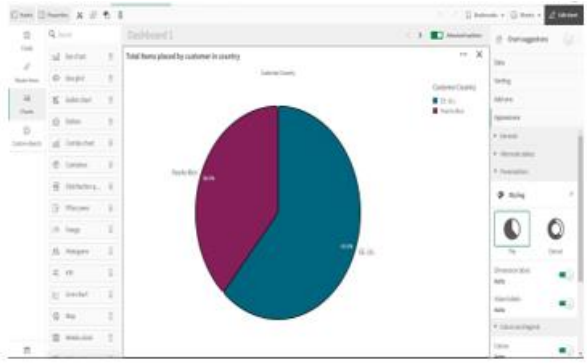
informed decision-making processes.

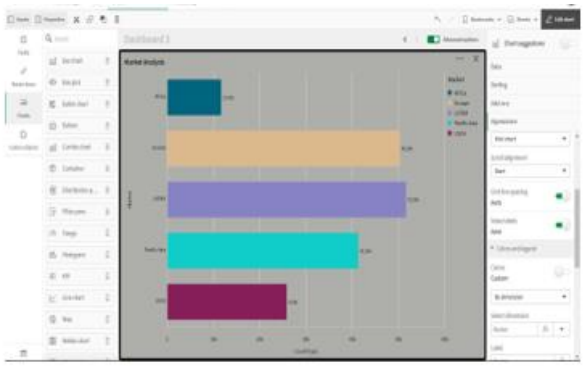
No Of Unique Visualisations

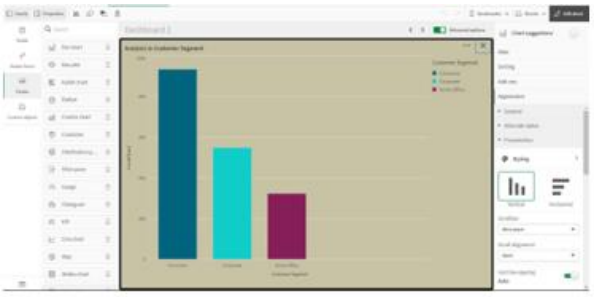
The number of unique visualisations that can be created with a given dataset. Some common types of visualisations that can be used to analyse the performance and efficiency include bar charts, line charts, heat maps, scatter plots, pie charts, Maps etc. These visualisations can be used to compare performance, track changes over time, show distribution, and relationships between variables, breakdown of revenue and customer demographics, workload, resource allocation.

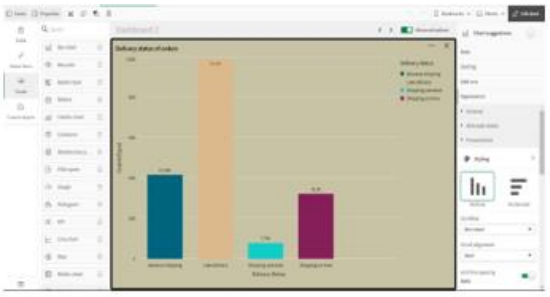
These are the following unique visualisations that can be observed in this project for the chosen data set.

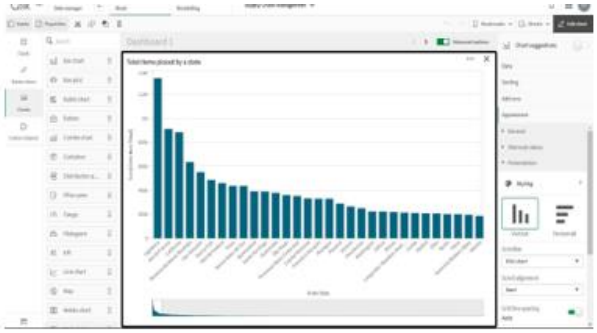
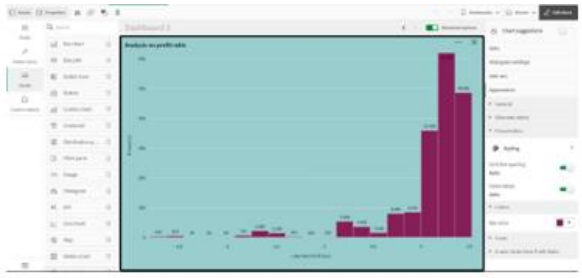






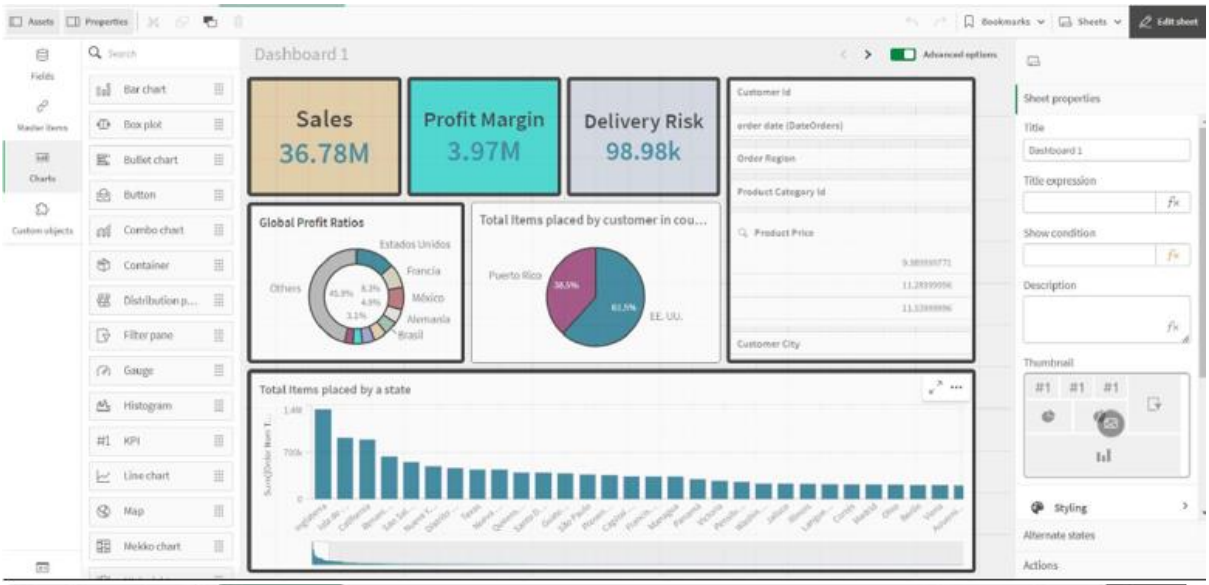


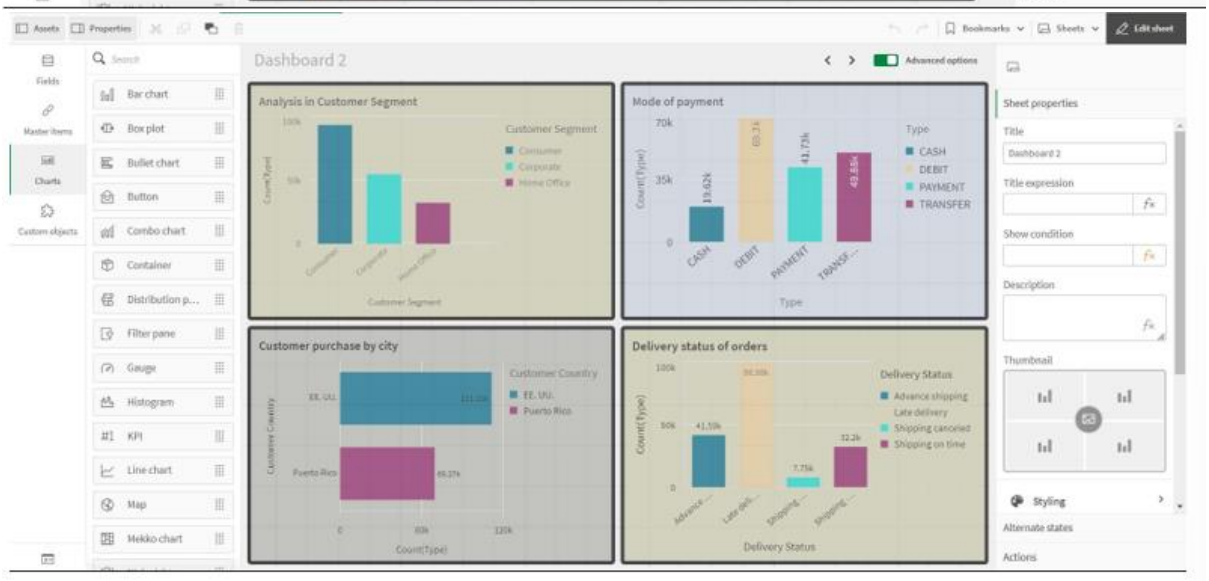



Dashboard

A dashboard is a graphical user interface that presents critical information and data in an organized, visually appealing, and easy-to-comprehend format. It serves as a centralised hub or control panel that consolidates and displays multiple data sources, key performance indicators (KPIs), and other essential metrics through interactive charts, graphs, tables, and other data visualisation elements. Dashboards leverage real-

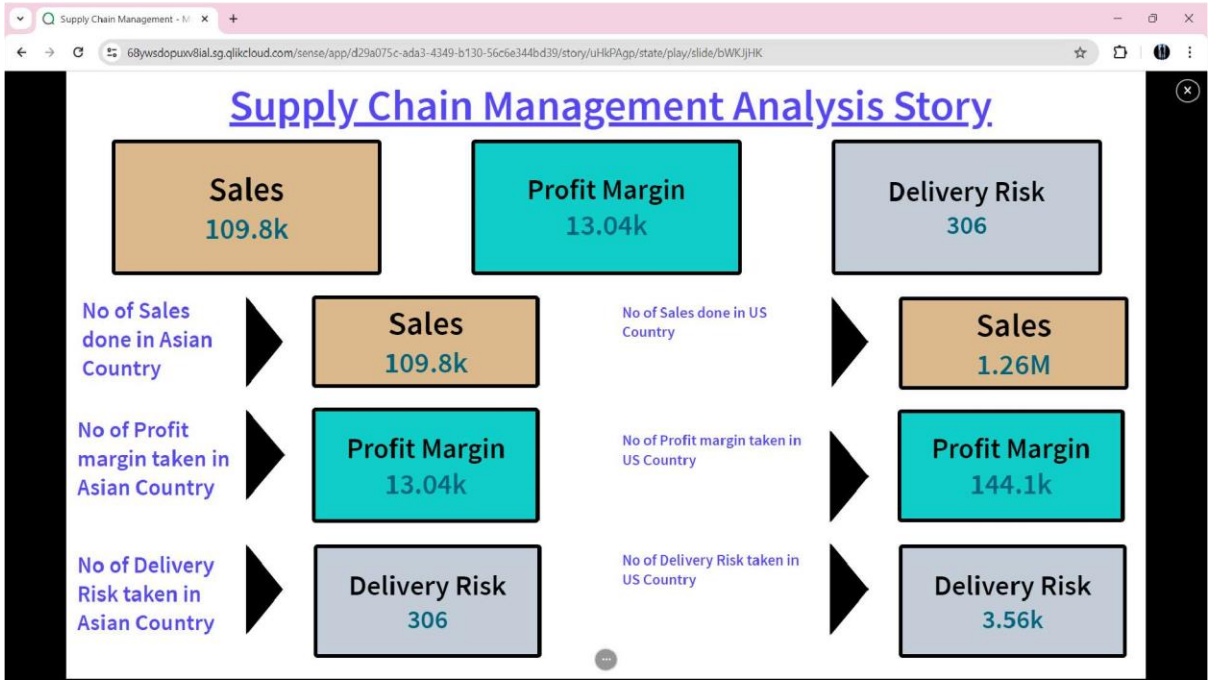

Dashboard 1
Sales
36.78M
Profit Margin
3.97M
Delivery Risk
98.98k
Global Profit Ratios
Estados Unidos
Francia
México
Alemania
Brasil
Others
Total Items placed by customer in cou...
Puerto Rico
EE. UU.
Total Items placed by a state
Customer Id
order date (DateOrders)
Order Region
Product Category Id
Product Price
Customer City
Sheet properties
Title
Dashboard 1
Title expression
Show condition
Description
Thumbnail
Styling
Alternate states
Actions


Dashboard 2
Analysis in Customer Segment
Customer Segment
Consumer
Corporate
Home Office
Mode of payment
Type
CASH
DEBIT
PAYMENT
TRANSFER
Customer purchase by city
Customer Country
EE. UU.
Puerto Rico
Delivery status of orders
Delivery Status
Advance shipping
Late delivery
Shipping canceled
Shipping on time
Sheet properties
Title
Dashboard 2
Title expression
Show condition
Description
Thumbnail
Styling
Alternate states
Actions

Story

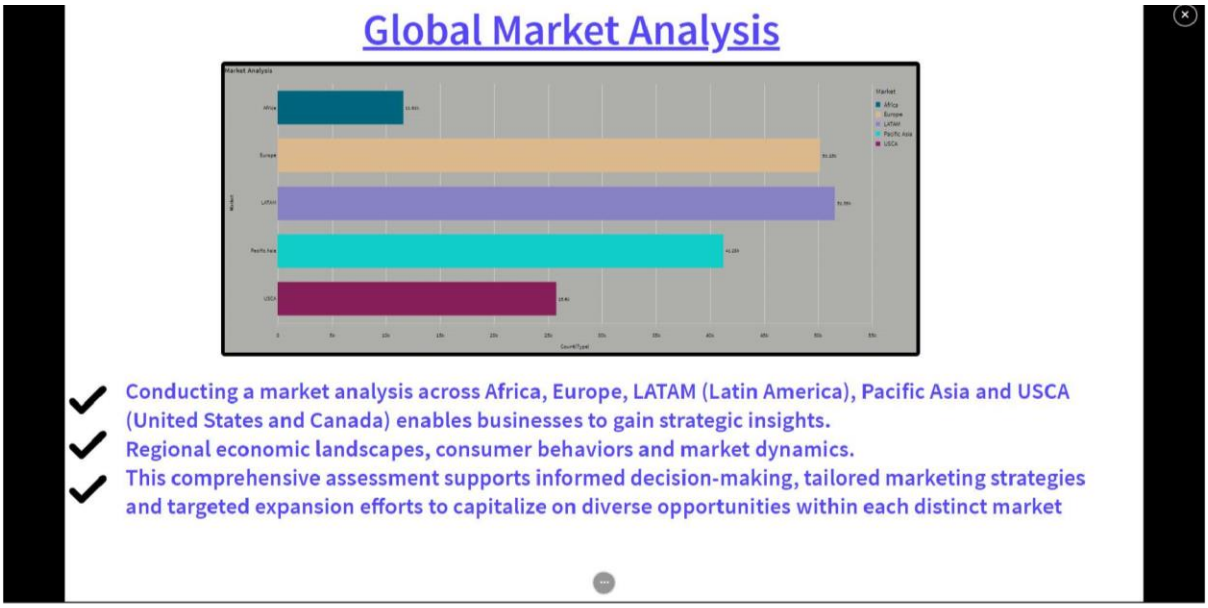
A data story is a narrative approach to presenting data and analysis in a way that is engaging, logical, and easy to comprehend. It involves structuring the information as a story, with a clear introduction that provides context and sets the stage, a body that systematically presents the data, analysis, and key findings through visualisations and explanations, and a conclusion that summarises the main insights and highlights their implications. Data stories aim to transform complex data into a cohesive and compelling narrative, guiding the audience through the data in a storytelling format. This approach leverages the power of storytelling to make data more relatable, memorable, and impactful. Data stories can be conveyed through various mediums, such as reports, presentations, interactive dashboards, or videos, making the information more accessible and understandable to a diverse audience.

The following figures explain the story of the graphs



time monitoring capabilities, providing up-to date visibility into data as it changes, allowing users to track performance and monitor metrics in real-time. They are specifically designed for targeted purposes or use cases, tailoring the displayed information to the needs of different users, teams, or industries. Dashboards are widely used across various sectors, such as business, finance, manufacturing, healthcare, and more, as they enable stakeholders to quickly grasp critical insights, identify patterns and trends, and make informed, data-driven decisions by presenting complex data in a visually appealing and digestible format.

The following project Dashboard looks like :



Conclusion

This project highlighted the significant role that data-driven innovations can play in enhancing supply chain management. By leveraging Qlik Sense Cloud Enterprise, we developed interactive visualisations, comprehensive dashboards, and informative data stories, which were instrumental in unlocking valuable insights and supporting informed decision-making processes. The creation of these dashboards enabled us to transform complex supply chain data into clear, actionable information. By presenting key performance indicators, operational metrics, and critical data points in a centralised and organized manner, stakeholders were able to monitor real-time performance, identify bottlenecks, and make well-informed decisions with greater ease and efficiency. Additionally, the data storytelling capabilities allowed us to contextualise the supply chain data, weaving together visualisations and explanations that provided a deeper understanding of the supply chain processes. This approach highlighted areas for improvement and identified opportunities for optimization, ultimately contributing to more efficient and effective supply chain operations. This project underscores the transformative impact of data-driven innovations in supply chain management, setting the stage for a future where data-driven decision-making is standard practice, enabling businesses to navigate the complexities of global supply chains with agility, resilience, and a commitment to excellence