DESIGNING A DIMENSIONAL MODEL FOR SALES ANALYSIS

INTRODUCTION

Dimensional modeling is crucial for enhancing query performance and enabling fast, efficient data retrieval. It consists of a central fact table containing quantitative data and multiple dimension tables with descriptive attributes related to the fact table. This model enhances query performance, simplifies complex data structures, and supports scalability and historical data analysis. The fact table is where metrics are aggregated, while dimension tables are used for filtering, grouping, and labeling data.

The objective of this report aims to design a dimensional model for sales analysis using auto service operations invoice. The model identifies and incorporate key data elements that are essential for understanding sales performance.

METHDOLOGY

In designing a dimensional model, it is important to note key decisions use in outlying the modelling of auto service business which includes:

- Business process
- Declaring the grain
- Identifying the dimension table
- Identifying the fact table

Auto-Service Business Process

The auto service business process begins with customer interaction, including inquiries and appointment scheduling. Upon arrival, vehicles are checked in, and service orders are created. Technicians diagnose issues, perform services, and parts to be used. Parts are ordered as needed and recorded in the system. Upon service completion, invoices are generated, summarizing services, parts, labor costs, and taxes. Payments are processed, and vehicles are returned to customers with detailed invoices.

This process captures detailed data at each shop location, allowing for comprehensive tracking of customer interactions, vehicle service histories, parts inventory, and financial transactions. By

monitoring performance across different locations, the repair shop ensures operational efficiency and supports informed decision-making.

Declaring The Grain

The grain of the fact table in the auto service data model is the smallest detail of each sales transaction. Each row represents one sale, capturing every service or part sold for a specific vehicle at a specific location and date. It includes information like the invoice number, customer details, vehicle details, services performed, parts used, total costs, taxes, and the payment due date.

This level of detail allows the shop to analyze each sale in depth, helping to understand customer preferences, track vehicle details, manage parts inventory, and monitor financial performance. By recording each transaction with this precision, the business can gain valuable insights and make informed decisions to enhance efficiency and customer satisfaction.

Identifying The Dimension Table

The dimension table is used to organize and categorize detailed data, providing context for transactional data in the fact table. In the auto service dimensional model, six-dimension attributes are identified to support sales analysis:

Customer Dimension: Is centered to capture and analyze customer-related information. It supports targeted marketing and personalized service offerings.

Vehicle Dimension: This is to track detailed information about each vehicle serviced. It allows for the analysis of vehicle service history and helps in identifying common issues and predicting future service needs.

Service Dimension: This is to record and analyze data about the services provided. It allows facilitates the evaluation of service performance.

Location Dimension: It allows for performance comparison across different locations. Helps in identifying high-performing and underperforming locations, guiding strategic decisions for resource allocation and potential expansion.

Part Dimension: This dimension supports inventory management, tracks parts usage trends, and monitors supplier performance. Helps in optimizing stock levels and reducing costs.

Date Dimension: It enables time-based analysis of sales, services, and operations. Supports trend analysis over various time periods and helps in identifying seasonal patterns and peaks in demand.

Identifying The Fact Dimension

The fact table is used to store quantitative data for business transactions, capturing detailed metrics such as sales amounts, service hours, and parts used. It serves as the central table in a dimensional model, enabling detailed analysis for sales performance. Key metric on fact table includes:

- **Sales_ID:** Total amount charged for service rendered
- **Invoice Number:** Unique identification number
- **Total Labor:** Total amount charged for service rendered
- **Total Parts:** Total amount charge for part used
- **Total Sales Tax**: Represents the overall tax amount on the transaction.
- **Table Sales Tax Rate**: Denotes the sales tax rate applied.
- **Total Cost**: Sums up the entire transaction cost, including services, parts, and taxes.

To perform a sales analysis in an auto service operation, the following analysis support this objective:

Customer Sales Analysis

Insights:

- Identify high-value customers that contribute to the sales performance.
- Analyze how frequently customers purchase services or part.

- Segment customers based on their visit.

Vehicle Sales Analysis

Insights:

- Identify top-performing vehicle types.
- Analyze maintenance costs associated with different vehicles.
- Determine service frequency trends for different vehicle types.

Part Sales Analysis

Insights:

- Identify high-demand and high-margin parts.
- Optimize inventory management based on part sales performance.
- Evaluate part usage trends and their impact on overall profitability.

Service Job Analysis

Insights:

- Identify the most and least profitable service jobs.
- Evaluate the efficiency of service operations.
- Optimize service offerings based on profitability.

Location-based Sales Analysis

Insights:

- Identify top-performing locations.
- Compare sales efficiency across different locations.
- Allocate resources based on location performance.

Tax Analysis

Insights:

- Evaluate the contribution of taxes to total revenue.

- Assess the impact of different tax rates on service and parts sales.
- Ensure compliance with tax regulations and optimize pricing strategies.

Date-Time Analysis

Insights:

- Identify seasonal sales patterns.
- Determine the impact of promotions or events on sales.
- Measure sales growth or decline over specific periods.

To perform sales analysis key information necessary to satisfy such analysis. Hence the following information are considered superfluous in respect to the invoice provided:

Vehicle Registration Number: From the invoice, vehicle identification number (VIN) is captured, which can be substitute for Vehicle registration number, which is not crucial in performing sales analysis.

Vehicle Color: This can be considered for detailed vehicle records, however it's not necessary in performing sales analysis

TABLE STRUCTURE

Fact Table: This table capture quantitative metrics for the sales analysis. Foreign keys from the dimension table allows comprehensive and flexible analysis across various dimension, providing insights into operational performance

Column Name	Column Type	Description
Sales ID	INT	Primary Key
Invoice ID	INT	Unique Key
Customer ID	INT	Foreign key to the customer dimension
Vehicle ID	INT	Foreign key to the vehicle dimension
Date ID	DATE	Foreign key to the date dimension
Service ID	INT	Foreign key to the service dimension

Part ID	INT	Foreign key to the part dimension
Location ID	INT	Foreign key to the location dimension
Total Labor	INT	Total number of jobs performed
Total Part	DECIMAL	Total number of parts used
Taxes	DECIMAL	Total taxes on each transaction
Total Transaction	DECIMAL	

Dimension Tables

Customer Dimension Table

Column Name	**Column Type**	
Customer_Id	INT	Primary Key
Name	Character	Customer Name
Address	Varchar	Customer Address
Phone	Varchar	Customer Phone

Vehicle Dimension Table

Column Name	**Column Type**	
Vehicle_Id	INT	Primary Key
Make	Varchar	Vehicle Make
Model	Varchar	Vehicle Model
Year	INT	Vehicle Year
Mileage	INT	Vehicle Mileage
VIN	Varchar	Vehicle Identification Number

Location Dimension Table

Column Name	Column Type	Description
Location_Id	INT	Primary Key
Location Name	Character	Name of repair shop
Address	Varchar	Address of the repair shop
City	Varchar	City of the repair shop
Province	Varchar	Province

Service Dimension Table

Column Name	Column Type	Description
Service_Id	INT	Primary Key
Service Hours	INT	Hours spent on a job
Service Rate	DECIMAL	Service rate
Service Sub Total	DECIMAL	Service cost without tax
Service Tax Rate	DECIMAL	
Service Cost	DECIMAL	

Part Dimension Table

Column Name	Column Type	Description
Part_Id	INT	Primary Key
Part Number	Varchar	Part Number
Part Name	Varchar	Name of the part
Part Quantity	INT	Quantity of part
Part Unit Price	DECIMAL	Unit price of part
Part Cost	DECIMAL	Total cost of parts
Part Sub Total	DECIMAL	Total cost without ta
Part Tax Rate	DECIMAL	

Date Dimension Table

Column Name	Column Type	Description
Date_Id	INT	Primary Key
Date	DATE	Actual date
Year	Varchar	Year
Month	Varchar	Month

Description Of Tables

Customer Table

- **Customer ID**: Uniquely identifies each customer for tracking and reference purposes.
- **Name**: Stores the name of the customer for identification and personalization.
- **Address**: Holds the address of the customer for billing and contact purposes.
- **Phone**: Keeps the phone number of the customer for communication and notifications.

Vehicle Table

- **Vehicle ID**: Uniquely identifies each vehicle for tracking and reference purposes.
- **Make**: Records the manufacturer of the vehicle for detailed vehicle information.
- **Model**: Specifies the model of the vehicle for detailed vehicle information.
- **Year**: Indicates the manufacture year of the vehicle for age and valuation purposes.
- **Mileage**: Records the mileage of the vehicle for maintenance and valuation purposes**.**

Location Table

- **Location ID**: Uniquely identifies each location for tracking and reference purposes.
- **Name**: Stores the name of the location for identification purposes.
- **Address**: Holds the address of the location for logistics and contact purposes.
- **City**: Specifies the city where the location is situated for geographical identification.
- **Province**: Indicates the province of the location for geographical identification

Service Table

- **Service ID**: Uniquely identifies each service job for tracking and reference purposes.
- **Service Hours**: Captures the amount of labor provided in hours for cost analysis.
- **Service Rate**: Specifies the hourly rate for the service provided.
- **Service Tax Rate**: Shows the applicable tax rate on the service.
- **Service Cost**: Reflects the total labor cost for the service rendered.

Part Table

- **Part ID**: Uniquely identifies each part for tracking and reference purposes.
- **Part Number**: Represents the part number for inventory and reference purposes.
- **Part Name**: Describes the name of the part for identification and inventory management.
- **Part Quantity**: Notes the number of parts used in the transaction.
- **Part Unit Price**: Specifies the price per part unit.
- **Part Cost**: Totals the cost of all parts used.
- **Part Tax Rate**: Indicates the tax rate applied to the parts.

Date Table

- **DateID**: Uniquely identifies each date for tracking and reference purposes.
- **Date**: Records the specific date for historical tracking and reference.
- **Year**: Indicates the year part of the date for time-based analysis and reference.
- **Month**: Specifies the month part of the date for time-based analysis and reference.

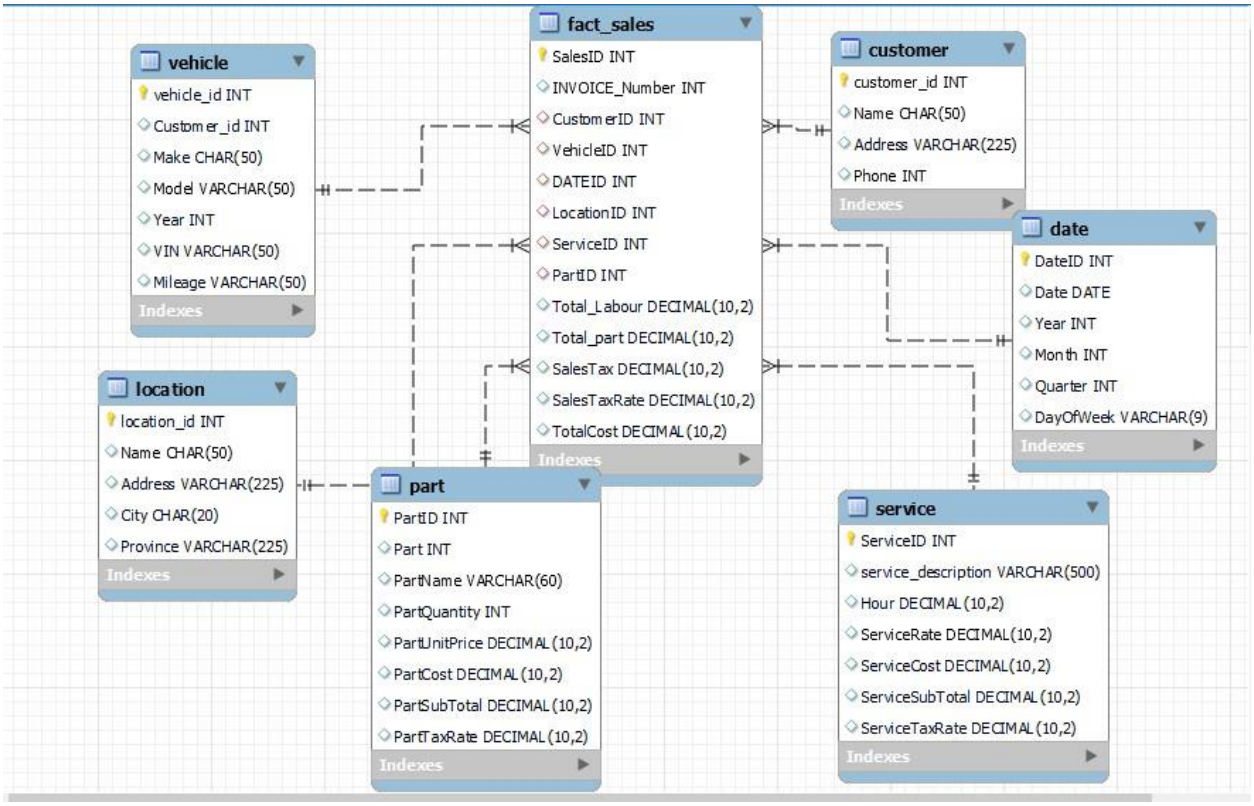
FACT_SALES TABLE

- **Sales ID**: Serves as a unique identifier for each sales transaction.
- **INVOICE ID**: Distinguishes each invoice uniquely for financial records.
- **Customer ID**: Associates the transaction with the specific customer for analysis.
- **Vehicle ID**: Connects the transaction to the respective vehicle for detailed tracking.
- **DATE ID**: Marks the date of the transaction for chronological analysis.
- **Location ID**: Ties the transaction to the specific location for geographical analysis.
- **Job ID**: Relates the transaction to the specific service job for detailed tracking.
- **Part ID**: Links the transaction to the involved part for inventory purposes.

- **Total Labor:** total number job performed in an operation
- **Total Part:** total number of parts used
- **Total Sales Tax**: Represents the overall tax amount on the transaction.
- **Table Sales Tax Rate**: Denotes the sales tax rate applied.
- **Total Cost**: Sums up the entire transaction cost, including services, parts, and taxes.

Entity-Relationship Diagram

Helps in understanding the overall architecture of a database system. The diagram below illustrate relationship between the tables.



Logical Explanation on Creating Tables from Sales Receipt

This is structure to give a detailed understanding of each table's purpose and its role in the overall analysis of the auto service operations.

Customer Table

The Customer Table is designed to store comprehensive information about the shop's customers. This table is instrumental in analyzing customer demographics and their history with the repair shop. It helps in understanding customer profiles and their interactions with the shop.

Vehicle Table

The Vehicle Table contains detailed information about the vehicles serviced by the shop. This table is crucial for tracking the service history of vehicles, examining the types of vehicles serviced, and analyzing trends based on vehicle make, model, and year. It supports insights into vehicle-related service patterns.

Location Table

The Location Table maintains data on the various shop locations. It facilitates geographic analysis of the shop's performance, allowing for the identification of trends and performance variations across different regions. This table aids in understanding regional differences in service demand and operational efficiency.

Service Table

The Service Table captures detailed information about the services provided by the shop. This table is essential for analyzing the types of services performed, labor hours involved, service costs, and overall service performance. It helps in evaluating service efficiency and cost-effectiveness.

Part Table

The Part Table records details about the parts used during services. This table plays a key role in managing inventory, understanding parts usage, and analyzing the costs associated with different parts. It supports inventory control and cost management.

Date Table

The Date Table provides a temporal context for transactions. It enables the analysis of trends over time, seasonality, and comparisons across different time periods. This table is vital for identifying temporal patterns and seasonal variations in service and sales activities.

Fact Sales Table

The Fact Sales Table serves as the central repository for transactional data related to the sales of services and parts. It integrates information from the Customer, Vehicle, Service, Part, Date, and Location tables. This table allows for a comprehensive analysis of sales performance, financial outcomes, and operational efficiency.

Conclusion

The dimensional model is design to provide framework in alignment with business analysis need thereby, providing sufficient information to perform sales analysis performance in an auto service operation

REFERENCE

https://www.kimballgroup.com/data-warehouse-business-intelligence-resources/kimball-techniques/dimensional-modeling-techniques/