Database Design and Final ERD

Vehicle-Dealership-Database-Management-System

Database Purpose:

The purpose of the database is to maintain the data used to assist and enhance the car sales process, maintenance service, inventory management, and parts procurements. It will be exclusively used by sales and administrative staff in sales and operations.

Business Problems Addressed:

- Facilitating efficient scheduling and tracking of maintenance services for vehicles, ensuring timely service delivery and customer satisfaction.
- Providing real-time visibility into vehicle inventory levels, enabling better decision-making regarding stock replenishment, pricing strategies, and sales promotions.
- Generating reports and analytics to assess sales performance, identify trends, and make data-driven decisions to improve sales and operational efficiency.
- Customer Relationship Management. The database stores customer data for personalized communication and targeted marketing, fostering stronger relationships.
- Inventory Optimization. Tracking inventory and supplier information enables proactive replenishment and cost-effective procurement decisions, minimizing costs.

Business Rules:

- **Employee** may have 0 or more **Quotes**, since the salesperson or advisor may associate with the quote, but the service people will not generate the quotes with customers.
- Each **Order** may only have and only one associated sales **Transaction** after each transaction has been finished, the order can be shipped.
- Each **Service** appointment may only be associated with one and only one **Vehicle**, customers who want to do service for more than one vehicle need to make other appointments. And there is only one **Team** taking charge of the service.
- Each buyer's payments for one **Order** need to be under only one sales **Transaction**.
- One **Customer** may place many orders, and process many **Transactions**.
- **Vehicle Inventory** can be checked by the **ConfigurationID**, every vehicle must have its corresponding ConfigurationID stored under the **Vehicle Information** table.
- **Employee** may proceed with 0 or more **Orders**, the salesperson may have many, but the service people will not.
- Each **Sale** has 0 or one **Shipment** record, based on customers' needs.

- **Suppliers** can supply both Vehicles and Parts. And some vehicles might come from the **Previous Owners**. Details of the vehicle's parts are stored in the **Parts Information.**
- Each **Shipment** must have a shipping **Address** on file to track.

Entity Name	Why Entity Included	How Entity is Related to Other Entities
Sales	The "Sales" entity is one of the most important entities for our business models, which captures information about each sale transaction, including the vehicles' order, the customer involved, and transaction details such as sales channel, sale price, payment method, finance detail, and billing information.	- The "Sales" entity links to "Shipment" one and only one to zero or one. Since the shipment could be processed only after the transaction has been finalized. But no vehicle needs to be shipped, the customer may choose to pick it up as well. "Sales" is connected to "Order" one and only one to one and only one by OrderID. - And connected "Customer" zero or more to one and only one. One customer could make zero or more orders, but each sale must be involved with a customer.
Order	Order is related to the sales, it contains the information of customers, corresponding employees, and the involved vehicle VIN, the order status, and the date. The delivery option will specify the way the customer gets the car, e.g. pick or delivery.	"Order" is connected to the "Employee" zero or more to one and only one, since a salesperson must be taking charge of this order. "Order" will be finalized when the payment goes through. Then it needs to be connected to the "Sales" entity. It is a one and only one to one and only one relationship. - Some "Order" might come from a successful "Quote". But it is not necessary. So the relationship is between zero or one to zero or one. - An "Order" must be established on a "Vehicle". Then it is a zero or one to one and only one relationship. Since cars in stock are not involved in orders.

Vehicle Information	Vehicles are the primary products sold by us. Including this entity allows us to check the car's information, like the current mileage and the status of the car, e.g. available, unavailable, or in service.	• "Vehicle_Information" to "Supplier" is zero or many to zero or one . A vehicle comes from a single supplier, but a supplier can provide multiple vehicles. This reflects the supply chain logistics. • "Vehicle_Information" to "Previous Owner" is one or many to zero or one. A vehicle can have one previous owner listed in this database (considering the most recent one for used vehicles), but a previous owner can have had multiple vehicles. • "Vehicle_Information" to "Configuration" is zero or many to one and only one . Each vehicle has a unique configuration ID, linking it to a specific set of features. This ensures that each vehicle's specifications are precisely documented. • "Vehicle_Information" to "ServiceTicket" is one and only one to zero or many . A vehicle can have multiple service tickets over its lifespan, but each service ticket is specific to one vehicle, reflecting ongoing maintenance and repair needs.
Configuration Inventory	This table stores the inventory level of each configuationID. People can check the inventory level by entering the ConfiguraionID	• Essential for smooth dealership operations, the "Vehicle Inventory" entity helps keep track of the available vehicles. It connects to one of the "Vehicle Information"'s attributes "MakeModelID", which helps people to look up the inventory by both Make and Model. So it has a relationship on and only one to one and only one to "Configuration"
ConfigurationI	This entity is to deal	• "Configuration Inventory" to

D	with the many-to-many situation. Each vehicle is linked to a unique CnfigurationID, and this table will contain all the information of each configuration.	"Configuration" is one and only one to one and only one. Each configuration uniquely corresponds to an inventory level, ensuring that each vehicle model's availability is accurately tracked. ● "Configuration Inventory" to "Vehicle_Information" is one and only one to zero or many.
Previous Owners	Including the "Previous Owners" entity allows the dealership to track the ownership history of vehicles.	● "Previous Owners" to be connected to "Vehicle Information" by the unique "VIN" number, one previous owner must be related to one or more cars. But not every car comes from the previous owner.
Customer	Under this database customers are the buyers of vehicles or the people who quote for the price of a certain vehicle. By including the customer entity, the dealership can maintain records of customer information, and contact details, enabling personalized sales and marketing efforts and fostering long-term relationships.	● The "Customer" entity is defined by a unique CustomerID, which is connected to the "Sales" entity one and only one to zero or many, each sale must connect to one customer, and the customer could make many orders or just quote for price rather than making the order.
Employee	Employees play various roles within the dealership, including salespersons, managers, and service staff. Including the employee entity allows for the management of employee information,	● The "Employee" entity is connected to "Quote" by EmployeeID one and only one to zero or more. Each Quote must involve a salesperson, but other staff can be quoted with the customer, like the service people. ● Same situation when connecting to "Order". ● The service people from the

	and roles, ensuring smooth operations and efficient customer service as well as customer employee interaction.	"Employee" are taking care of the service, but other positions are not involved at all. So the relationship is one or more to zero or more.
Supplier	Suppliers provide both vehicle and vehicle parts dealership operations. Including the Supplier the entity allows for the management of Suppliers' information.	- The "Supplier" entity is linked to the "Part Information" entity, where each part is associated with exactly one supplier, illustrating a one and only one to zero or more relationship from the part to the supplier. - Since the other suppliers might only supply vehicles. So it is a zero or one to zero or more relationship connected to "Vehicle Information".
Service	After-sales service and maintenance are important aspects of the vehicle ownership experience. Including the service entity allows for the management of service appointments, tracking service history, tracing back the working team, and other details.	- The "Service" entity is connected to Vehicle Information by "VIN", every service must be related to one vehicle, and a vehicle can have several services in its history or zero. So it is a zero or more to one and only one relationship. "Service" is connected to "Employee" since the service person is part of the employee. One service must be involved with one or more service people, but not all the employees are service people. So it is a zero or more to one or more relationships.
Part Information	The "Part Information" entity stores information about vehicle parts, including details from suppliers. This data is crucial for managing inventory levels, tracking part details, and ensuring the	"Part Information" is connected to the "Supplier", since all the parts come from the suppliers. Zero or more to one and only one relationship has been established here since some of our suppliers might only supply vehicles.

	availability of parts for service and repairs.	
Quote	The "Quote" entity is necessary to capture information about sales quotes, including details about involving employees, and customers, quote date, quote price and the desired vehicles' details. This data supports the quoting process and provides insights into potential sales transactions, facilitating effective communication between the dealership and customers.	● Each "Quote" must involve one "Customer" and one "Employee", but only every customer or employee must participate in this process. So it is a zero or many to one and only one relationship to both entities. ● A successful "Quote" might lead the customer to place an order. However, some customers might not be satisfied with the quoted price. Therefore, this is a zero or one to zero or one relationship here.
Address	The "Address" entity is included to manage information about shipping addresses related to shipments. This data is crucial for the logistics and delivery processes, ensuring accurate and timely deliveries to customers.	● The "Address" is only connected to the "Shipment" entity. Every shipment must need a final destination, and an address might receive multiple orders. So it is a one and only one to one or more relationship.
Shipment	The "Shipment" entity is included to facilitate the management of shipments, including information about the shipment status, and shipper's details, shipment dates, arrival date, tracking number, and shipping method. This data is vital for tracking the delivery	● When people need the car to be shipped, then the "Shipment" needs to be connected to the "Sales" entity. So it is a zero or one to one and only one relationship to "Sales". ● "Shipment" to "Address" is listed above.

	process and ensuring timely and accurate deliveries to customers.	
Team	To avoid the complex many-to-many situation between service and employee, We've introduced a "team" entity. Now each service tickets is linked to a single team, and we can also trace back the service employee.	• Each "Service" is linked to a unique service "team". One "team" can be involved with many services. • One service"employee" only works in one team, but one "team" could contain many service employees.

Relationships:

- **"Order" to "Vehicle Information" (zero or one to one and only one):**
  One order must correspond to mandatory one vehicle, but one vehicle does not need to be associated with one order.
- **"Employee" to "Order" (zero or many to one and only one):**

An employee may process zero or more orders, but each order is processed by one and only one employee (salesperson).

- **"Configuration" to "Vehicle Information" (one and only one to many):**
  Each ConfigurationID has one and only one set of vehicle information, many vehicles can be the same configurationID which is a one-to-many relationship.
- **"Configuration" to "Configuration Inventory" (one and only one to one and only one)**
  To avoid many to many relationships between vehicle to configuration inventory. Configuration is added. One vehicle only has 1 configurationID.
- **"Vehicle Information" to "PreviousOwners" (one or many to optional one):**
  A vehicle may have had zero or more previous owners, but each previous owner record is associated with one or many vehicles.
- **"Sales" to "Order" (one and only one to one and only one):**
  Each sales transaction is associated with one and only one order and each order is associated with one and only one sales transaction.
- **"Customer" to "Sales" (zero or many to one and only one):**
  A customer may have zero or more sales, but each sale is associated with one and only one customer.
- **"Service" to "Vehicle Information" (zero or many to optional one):**
  A vehicle may have zero or more service records, but each service record is associated with one and only one vehicle.
- **"Part Information" to "Supplier" (zero or many to one and only one):**
  A part must have one and only one supplier, but each supplier can provide zero or many types of parts.
- **"Employee" to "Quote" (zero or many to one and only one):**
  An employee may create zero or more quotes, but each quote is created by one and only one employee.
- **"Shipment" to "Address" (one and only one to one and only one):**
  Each shipment is sent to one and only one address and each address can receive one or more shipments.
- **"Sales" to "Shipment" (one and only one to zero or one)**
  Each sale may be related to zero or one shipment, a customer may choose to pick up the car or ship the car. Shipment must be related to one sale.
- **"Quote" to "Customer" (zero or many to one and only one):**
  A customer may make zero or more quotes, but each quote is associated with one and only one customer.
- **"Quote" to "Order" (zero or one to zero or one):**
  An order may be associated with zero or one quote, and vice versa.
- **"Vehicle Information" to "Supplier" (one or more to zero or one)**
  One Vehicle could be from one Supplier, and Each Supplier may offer many cars

- **"Team" to "Employee" (many to one)**
  We added a team to the end between service and employee, because many employees can work on one vehicle, in order to avoid many to many relationships, we created a team entity and divided the employees into many teams. Only one team can work on one vehicle, but many employees can be in one team.

Views and Functions

We created several views during the database management for clarity

- **Most Valuable Salesperson**: By adding the view, we can get the access of the employees in the ranking of orders they entered.
- **Most Valuable Team**: By adding the view, we can get the ranking of the service team, by counting and ranking the serviceTicketID.
- **SalesChannel:** We added a function to create a computed column in the sales channel. Indicating the percentage of each purchasing channel method overall.
- **TeamServiceTickets**: Due to the limitation of TeamID as the PK of the entity, we created the view to show the service tickets for each team.
- **InventoryLevelStatus:** We added a computed function in inventory level table, when the inventory level is above 10, it generate high level in the new column, if it is under 10 above 3, the level will be normal, if it is under 3, it will be low level.
- **ServiceWithPartInfo**: We added this view to the service table to identify the parts that were used in the service by using left join the service info.
- We also added **constraints** for date of birth and phone number in the customer table to limit the data entered in this table.
- New columns named **Quote Differences** are also computed by having the quote price minus the sales amount, showing in the sales table.
- We also added constraints on the customer birthdays need to be before the present date, and the order dates need to be earlier than ship dates, the ship dates need to be earlier than delivery dates.

Visualization With Tableau:

- **Delivering Status Bar chart:**
  We have 6 orders reach their destinations and 6 orders currently in transit and Shipped order has the highest count Reflecting a logistics scenario where items are quickly moved out from the shipment point but still in the early stage of delivery.

Status
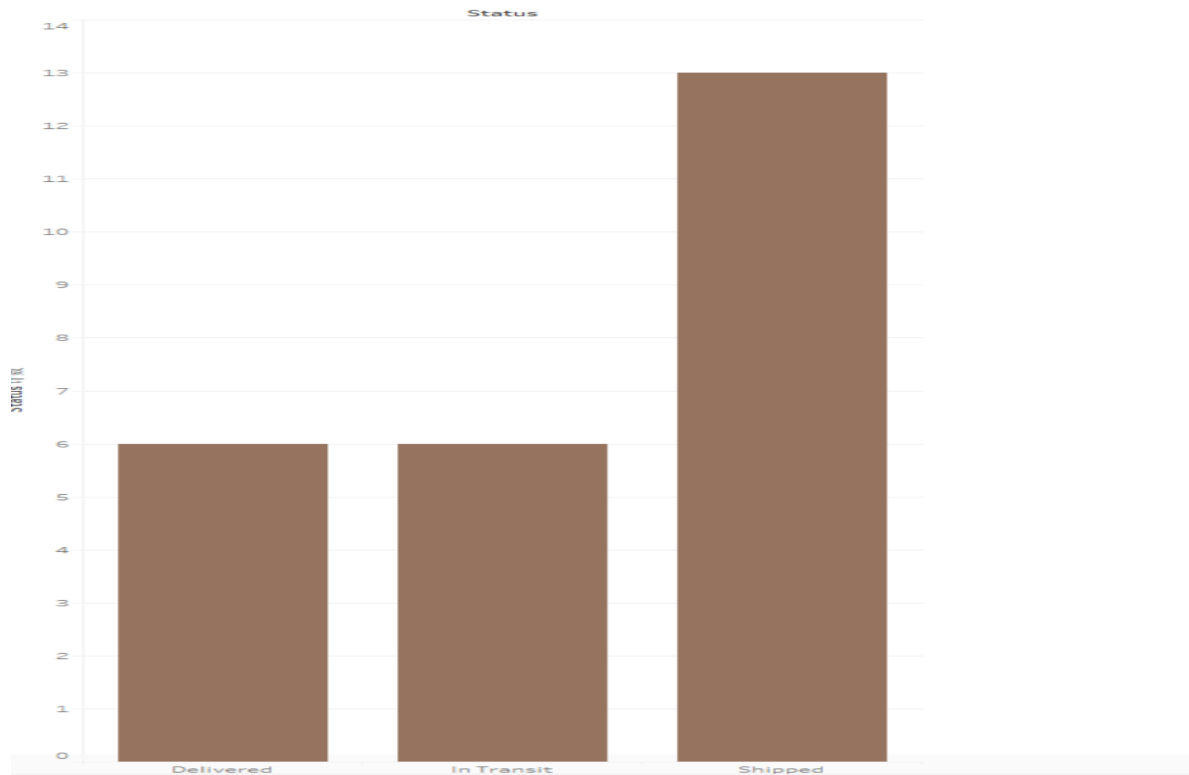
- **SalesChannels Pie Chart:**
- In-Store" sales, accounting for 33.33% of total sales. Indicates that one third of customers prefer to make their purchases directly at the physical dealership location.
- "Phone" and "Online" sales are equally significant, accounting for 23.33% of sales which means nearly half of the customers are comfortable making purchases remotely.
- "Third Party" contributes to 20% of the sales. Indicates that partnerships with third-party sellers are important, but they only take a smaller fraction of sales compared to direct and remote channels operated by the dealership.
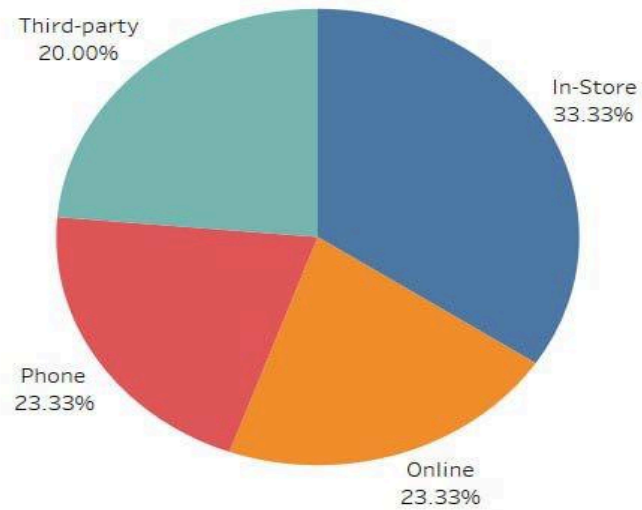
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- **Geographic Distribution Of Orders:**
  The map shows the geographic distribution of sales for a vehicle dealership.
  - **High Sales Concentration**: The darker shaded area indicates a higher concentration of sales. This suggests that the dealership's customer base is densely populated in this region, or it could be due to higher economic activity or a larger population.
  - **Least Sales**: Lighter lighter-shaded areas, sales are present but less concentrated.
  - **Sales strategies:** Darker areas could focus on customer retention strategies, while the lighter areas might benefit from increased marketing to boost sales.

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-Age Distribution Bar Chart:

The bar chart represents the age distribution of customers at a vehicle dealership. The whole graph suggests that certain age groups are more inclined to buy vehicles or that the dealership has targeted its marketing towards these segments more effectively.

- **Peak Age Group**: The 60-65 age bin has the highest count with 5 customers. Suggesting that people in this age range are the most frequent buyers or the primary customer base for this dealership.
- **Younger Customers**: The 20-30 age bins have the lowest count.
- **Older Customer**: There are 4 customers in the 75-80 age bin.

Age Distribution
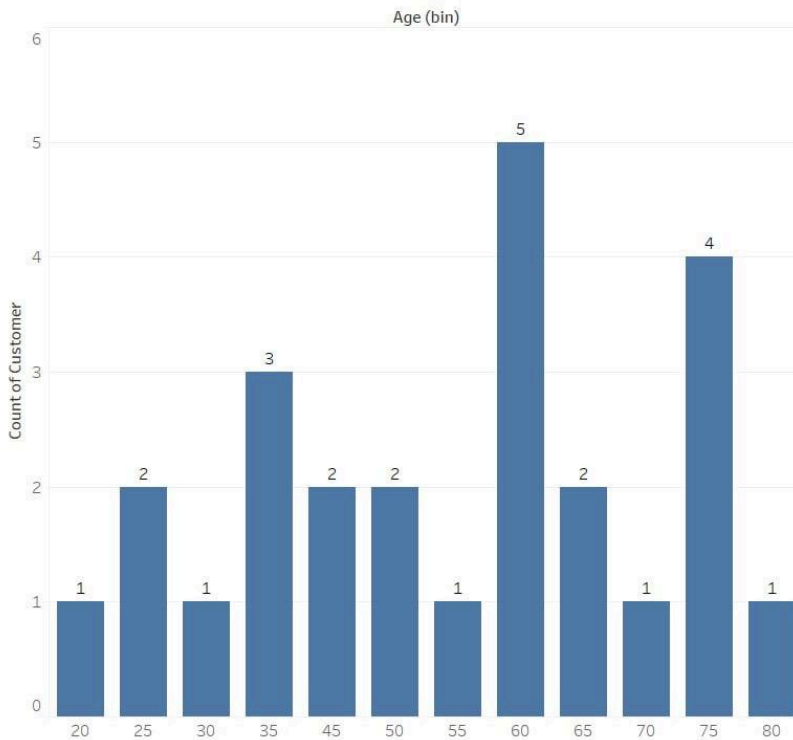
-**Month and vehicle sales line chart:**

The line chart illustrates the monthly sales trends for a vehicle dealership over a year. This information could be valuable for planning marketing strategies, inventory management and sales forecasts, as it indicates when the dealership might need to sharpen up promotional efforts or expect lower customer traffic.

- **Sales Peaks**: The highest peaks occur in February and November. These months may have strong sales promotions or seasonal buying behavior.
- **Lowest Sales**: The lowest point in sales is seen in January, with sales around 50K. This period of lower customer interest or external factors.
- **End of Year**: Sharp decrease in sales after November. Attributed to holiday closures, end-of-year financial considerations, or other seasonal factors.

Monthly Sales

Improvement

      The data that we have used in this implementation of the dataset is randomly generated but follows a basic ERP logic. The consistency of the data was not clear, for example, payment and financing. We will need to ensure if the customer is paying cash, the financing methods need to be unavailable or none.

      In the Vehicle Information table, all vehicles' data needs to be entered into the table. The status of the vehicle needs to be clarified whether the car is available for sale or service vehicle in service or ready to pickup.

      At the beginning of our project, we aimed to identify the quote and order conversion rate and the amount differences between quotes and orders. As we worked on the projects, the order and quote conversion had a difficult logic that we had thought. We ended up dropping the orderID in the quote table.

Business problem Addressed

      The features in this dataset provide efficient service scheduling and tracking. Which increases customer satisfaction during the buying and service process. It also enhanced the inventory visibility to decision-makers on stock, pricing, and promotions with real-time insights. It will generate reports for analysis to identify sales trends and make informed decisions when it comes to efficiency of organization management and sales. It can be used to Implement Customer Relationship Management and Enterprise Resource Planning systems. This will strengthen the salesforce and marketing, leverage the stored customer data and manage customer

relationships with personalized communication. And finally enhancing inventory optimization to minimize costs with proactive inventory tracking, smart procurement, and balancing stock levels effectively.