Technical Sales Report: Optimizing Operations for a Car Repair Shop

Introduction

In today's competitive automotive service industry, optimizing operations is crucial to stand out, enhance customer satisfaction, and drive profitability. This report delves into the details of a car repair shop's data, transforming raw numbers into strategic insights. By meticulously analyzing key performance indicators (KPIs) from the sales data, the report unveils hidden patterns and opportunities for improvement, reveals actionable strategies to fine-tune operations, satisfy customers, and unlock the full potential of the repair shop.

Objective

The primary objectives of this analysis are to:

- Identify KPIs relevant to the car repair shop's operations.
- Analyze customer spending, vehicle metrics, service performance, parts usage, and financial metrics.
- Provide optimization recommendations based on the analysis results.

Data Overview

The analysis is based on data from customer records, vehicle details, job performance, parts usage, and invoices. The key data sources include:

1. **Customer Data:** Information about customers including name, address, and phone number.
2. **Vehicle Data:** Details about vehicles such as make, model, year, color, VIN, registration number, mileage, and owner name.
3. **Job Data:** Records of jobs performed on vehicles, including job description, hours, rate, amount, and invoice ID.
4. **Parts Data:** Information on parts used in repairs, including part number, part name, quantity, unit price, amount, and invoice ID.
5. **Invoice Data:** Summary of invoices, including invoice date, subtotal, sales tax rate, sales tax, total labor, total parts, total amount, customer ID, and vehicle ID.

Methodology

The analysis was conducted using SQL queries to extract insights from the relational database. The steps involved:

Creation of the Relational Database:

- **Database Setup**: A relational database named **CarRepairShop** was created.

```
1
2       -- CREATING DATABASE CarRepairShop
3 •     CREATE DATABASE CarRepairShop;
4 •     USE  CarRepairShop;
5
```

- **Table Creation**: Tables were created for each data category: Customer, Vehicle, Jobs, Parts, and Invoice, based on the provided CSV files.

```
-- Creating Customer Table                    -- Creating Jobs Table
CREATE TABLE Customer (                        CREATE TABLE Jobs (
    CustomerID INT PRIMARY KEY AUTO_INCREMENT,     JobID INT PRIMARY KEY,
    Name VARCHAR(100),                             VehicleID INT,
    Address VARCHAR(255),                          Description VARCHAR(255),
    Phone VARCHAR(20)                              Hours DECIMAL(10, 2),
);                                                 Rate DECIMAL(10, 2),
                                                   Amount DECIMAL(10, 2),
                                                   InvoiceID INT,
-- Creating Vehicle Table                          FOREIGN KEY (VehicleID) REFERENCES Invoice(VehicleID),
CREATE TABLE Vehicle (                             FOREIGN KEY (InvoiceID) REFERENCES Invoice(InvoiceID)
    VehicleID INT PRIMARY KEY AUTO_INCREMENT,  );
    Make VARCHAR(50),
    Model VARCHAR(50),
    Year YEAR,                                 -- Creating Parts Table
    Color VARCHAR(20),                         CREATE TABLE Parts (
    VIN VARCHAR(50),                               PartID INT PRIMARY KEY,
    Reg No VARCHAR(50),                            JobID INT,
```

- **Column Addition**: New columns such as CustomerID and VehicleID were introduced to the Customer_Details and Vehicle_Details table as unique identifiers for better data integrity and efficient querying.

Data Ingestion and Preparation:

- **Importing Data:** Imported the provided CSV files into a relational database.

```sql
-- LOADING DATA INTO DIMENSION TABLES
LOAD DATA INFILE 'C:/ProgramData/MySQL/MySQL Server 8.0/Uploads/customer.csv'
INTO TABLE Customer
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS
(Name, Address, Phone);


LOAD DATA INFILE 'C:/ProgramData/MySQL/MySQL Server 8.0/Uploads/vehicle.csv'
INTO TABLE Vehicle
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS
(Make, Model, Year, Color, VIN, Reg_No, Mileage, OwnerName);
```

```sql
LOAD DATA INFILE 'C:/ProgramData/MySQL/MySQL Server 8.0/Uploads/job.csv'
INTO TABLE Jobs
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;

LOAD DATA INFILE 'C:/ProgramData/MySQL/MySQL Server 8.0/Uploads/parts.csv'
INTO TABLE Parts
FIELDS TERMINATED BY ','
ENCLOSED BY '"'
LINES TERMINATED BY '\n'
IGNORE 1 ROWS;

LOAD DATA INFILE 'C:/ProgramData/MySQL/MySQL Server 8.0/Uploads/invoice.csv'
INTO TABLE Invoice
FIELDS TERMINATED BY ','
```

Data Cleaning and Preparation:

- **Check for Duplicates**: Ensured there were no duplicate entries in each table.
- **Validate Foreign Keys**: Verified that all foreign key references were valid and consistent across tables. For example, ensured that all VehicleID references in the Jobs table existed in the Vehicle table.
- **Check for Null Values**: Ensured mandatory fields did not contain null values. For example, checked that all invoices had associated CustomerID and VehicleID.
- **Standardize Data Formats**: Standardized data formats, such as Date and phone numbers in to a consistent format.
- **Indexing**: Created indexes on commonly queried fields to improve performance. For example, indexes were created on Name in the Customer table for faster searches.

```sql
-- CLEANING AND FORMATTING DATA
-- Handle missing values
UPDATE Customer
SET Phone = 'Unknown'
WHERE Phone IS NULL;


-- Standardize data formats
UPDATE Customer
SET Name = UPPER(Name);
UPDATE Vehicle
SET OwnerName = UPPER(OwnerName);


-- Validate data
DELETE FROM Vehicle
WHERE Mileage < 0 OR Mileage > 1000000;
```

```sql
-- Indexing
CREATE INDEX idx_customer_name ON Customer(Name);
CREATE INDEX idx_vehicle_make_model ON Vehicle(Make, Model);
CREATE INDEX idx_vehicle_vin ON Vehicle(VIN);
CREATE INDEX idx_jobs_vehicle_invoice ON Jobs(VehicleID, InvoiceID);
CREATE INDEX idx_parts_job_invoice ON Parts(JobID, InvoiceID);
CREATE INDEX idx_invoice_customer_vehicle ON Invoice(CustomerID, VehicleID);
CREATE INDEX idx_invoice_date ON Invoice(InvoiceDate);
```

Data Analysis:

1. **Customer Analysis:** Identified top customers, average spending, and visit frequency.

```
1      -- Customer Analysis
2      -- TOP 5 CUSTOMERS WHO HAVE SPENT MOST ON VEHICLE REPAIRS
3      SELECT C.Name, SUM(I.Total) as Total_Spending
4      FROM Customer as C
5      JOIN Invoice I on C.CustomerID = I.CustomerID
6      GROUP BY C.Name
7      ORDER BY Total_Spending DESC;
8
9      -- OR AVERAGE SPENDING OF CUSTOMERS ON REPAIRS AND PARTS
10 •   SELECT AVG(I.Total) AS Average_Spending
11     FROM Invoice I;
12
13     -- ANALYZING THE FREQUENCY OF CUSTOMER'S VISITS
14 •   SELECT C.Name, COUNT(I.InvoiceID) AS Visits
15     FROM Customer as C
16     JOIN Invoice I on C.CustomerID = I.CustomerID
17     JOIN Jobs J on I.invoiceID = J.InvoiceID
18     JOIN Parts P on J.JobID= P.JobID
19     GROUP BY C.Name
20     ORDER BY Visits DESC;
```

2. **Vehicle Analysis:** Calculated average mileage, identified common makes and models, and analyzed vehicle age distribution.

```
1      -- Vehicle Analysis:
2      -- AVERAGE MILLAGE OF SERVICED VEHICLES
3 •    SELECT ROUND(AVG(Mileage), 2) AVG_Milage
4      FROM Vehicle as V
5      JOIN Jobs as J ON V.VehicleID = J.VehicleID;
6
7      -- MOST COMMON VEHICLES BROUGHT IN FOR SERVICING
8 •    SELECT V.Make, V.Model, COUNT(J.VehicleID) as Frequency
9      FROM Vehicle V
10     JOIN Jobs J ON V.VehicleID = J.VehicleID
11     GROUP BY V.Make, V.Model
12     ORDER BY Frequency DESC;
13
14
15     -- DISTRIBUTION OF VEHICLE AGES AND TREND IN SERVICING BASED ON AGE
16 •   SELECT V.Year, COUNT(J.VehicleID) as Frequency
17     FROM Vehicle as V
18     JOIN Jobs as J ON V.VehicleID = J.VehicleID
19     GROUP BY V.Year
20     ORDER BY Frequency DESC;
```

3. **Job Performance Analysis:** Determined common job types, total revenue from each job, and jobs with highest and lowest average costs.

```
1     -- Job Performance Analysis:
2     -- THE MOST COMMON JOBS PERFORMED AND THEIR FREQUENCY
3 •   SELECT J.Description, COUNT(Description) AS Frequency
4     FROM Jobs as J
5     GROUP BY J.Description
6     ORDER BY Frequency DESC;
7
8     -- TOTAL REVENUE GENERATED FROM EACH JOB.
9 •   SELECT J.Description, SUM(J.Amount) AS TotalRevenue
10    FROM Jobs as J
11    GROUP BY J.Description
12    ORDER BY TotalRevenue DESC;
13
14    -- JOBS WITH THE HIGHEST
15 •  SELECT J.Description, ROUND(AVG(J.Amount), 2) AS AVG_Cost
16    FROM Jobs as J
17    GROUP BY J.Description
18    ORDER BY AVG_Cost DESC
19    LIMIT 5;
20
```

4. **Parts Usage Analysis:** Obtained frequently used parts, calculated average cost of parts, and determined total revenue from parts sales.

```
1     -- Parts Usage Analysis:
2     -- TOP 5 MOST USED PARTS AND FREQUENCY.
3 •   SELECT P.PartName, SUM(P.Quantity) as Frequency
4     FROM Parts as P
5     GROUP BY P.PartName
6     ORDER BY Frequency DESC
7     LIMIT 5;
8
9     -- AVERAGE COST OF PARTS USED IN REPAIRS.
10 •  SELECT ROUND(AVG(Amount), 2) as Average
11    FROM Parts as P;
12
13    -- TOTAL REVENUE FROM PART SALES.
14 •  SELECT SUM(Amount) as TotalRevenue
15    FROM Parts as P;
16
```

5. **Financial Analysis:** Calculated monthly revenue, overall profitability, and impact of sales tax on revenue.

```sql
1    -- Financial Analysis:
2    -- TOTAL REVENUE GENERATED FROM LABOR AND PARTS EACH MONTH.
3 ●  SELECT DATE_FORMAT(I.InvoiceDate, '%Y-%M') AS MONTH,
4    SUM(I.TotalLabour) as TotalRevenue_Labour,
5    SUM(I.TotalParts) as TotalRevenue_Parts,
6    SUM(Total) as TotalRevanue
7    FROM Invoice as I
8    GROUP BY Month
9    ORDER BY Month;
10
11   -- OVERALL PROFITABILITY OF REPAIR SHOP.
12 ● SELECT SUM(I.Total) AS TotalRevenue,
13       SUM(I.TotalLabour + I.TotalParts) AS TotalCosts,
14       SUM(I.Total) - SUM(I.TotalLabour + I.TotalParts) AS Profit
15   FROM Invoice I;
16
17   -- IMPACT OF SALES TAX ON TOTAL REVENUE.
18 ● SELECT SUM(I.Total) AS TotalRevenue,
19       SUM(I.SalesTax) AS TotalSalesTax,
20       SUM(I.Total) - SUM(I.SalesTax) AS Revenue_Without_Tax
21   FROM Invoice I;
```

Findings and Observations from Analysis

1. Customer Analysis:

- **Top 5 Customers by Total Spending:** The top customers by spending are Jennifer Robinson, David Wilson, Emily Brown, Michael Smith, and Sarah Johnson. Jennifer Robinson is the highest spender with $1802.20.

Name	Total_Spending
Jennifer Robinson	1802.20
David Wilson	837.20
Emily Brown	664.00
Michael Smith	617.25
Sarah Johnson	376.00

Implications and Action:

High-value customers like Jennifer Robinson, David Wilson, and Emily Brown significantly contribute to the shop's revenue. Retaining these customers is crucial for maintaining and increasing revenue. Implement loyalty programs, personalized offers, and targeted marketing campaigns to retain these high-spending customers.

- **Average Spending of Customers:** The average spending per customer is $859.33, indicating that a significant amount of revenue is generated per customer.

	Average_Spending
▶	859.33

Implications and Action:
The high average spending per customer indicates that each customer visit is valuable. This suggests that enhancing the customer experience and encouraging repeat visits can further boost revenue. Focus on customer service improvements and create incentives for customers to return, such as follow-up reminders for regular maintenance.

- **Frequency of Customer Visits:** Jennifer Robinson has the highest visit frequency (3 visits), while other top customers visit 1-2 times. This suggests that retaining high-value customers can substantially impact revenue.
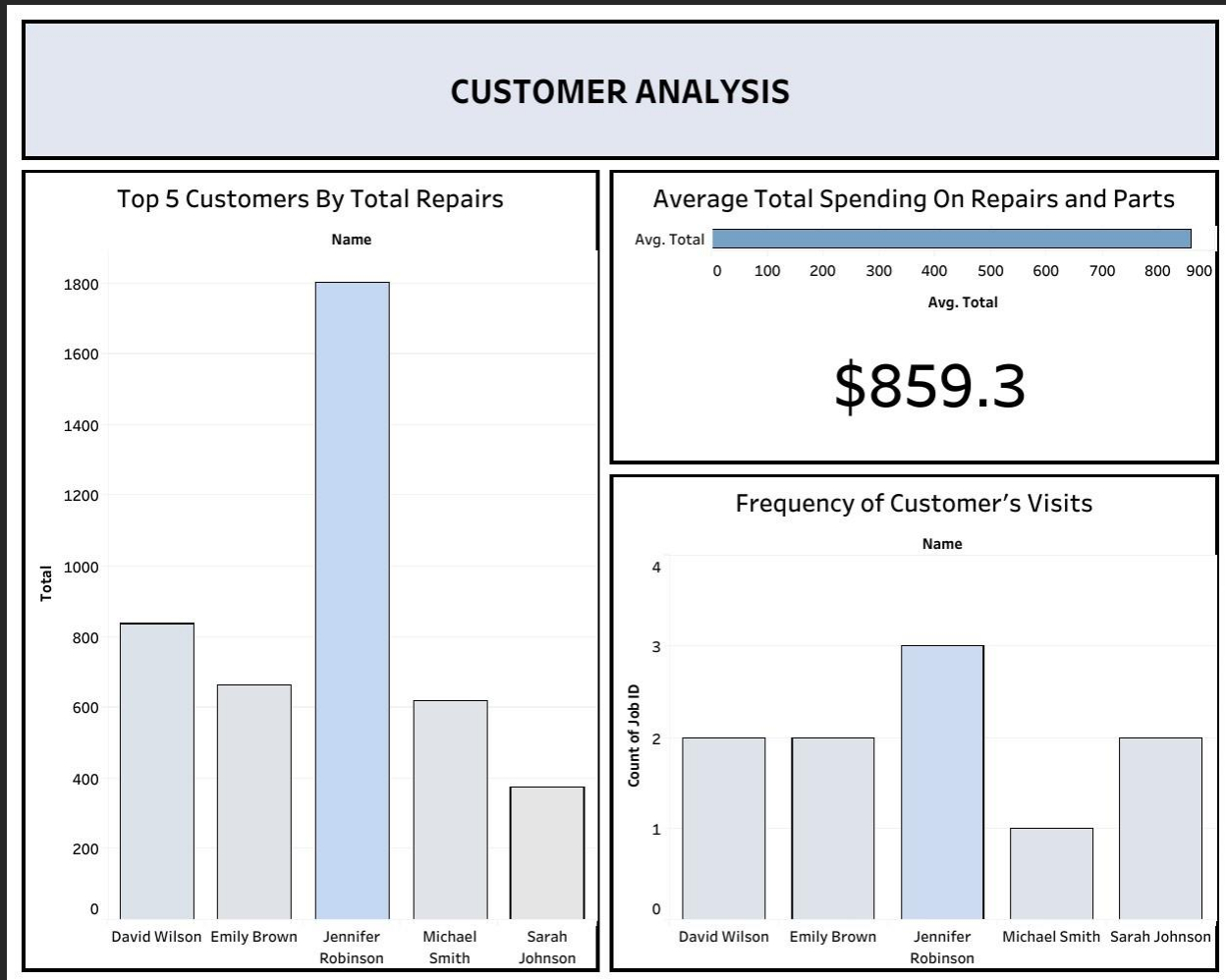
	Name	Visits
▶	Jennifer Robinson	3
	David Wilson	2
	Emily Brown	2
	Sarah Johnson	2
	Michael Smith	1

Implications and Action:
Customers with frequent visits, such as Jennifer Robinson, are key to sustained revenue. Understanding their needs and preferences can help in providing personalized services that encourage loyalty. Analyze the services frequently used by these customers and tailor offerings to meet their specific needs, ensuring they continue to choose the shop for their vehicle maintenance.

A visualization of insights derived from the Customer Analysis.

CUSTOMER ANALYSIS

Top 5 Customers By Total Repairs

Average Total Spending On Repairs and Parts

$859.3

Frequency of Customer's Visits

2. Vehicle Analysis:

- **Average Mileage of Vehicles Serviced**: The average mileage of serviced vehicles is 33,299 miles. This indicates a tendency for servicing vehicles that have substantial usage, possibly leading to more frequent and diverse repairs.

AVG_Milage
33299.00

Implications and Action:
Vehicles with substantial mileage are more likely to need diverse and frequent repairs. This presents an opportunity to offer specialized services for high-mileage vehicles.

Develop and market maintenance packages tailored for high-mileage vehicles to attract customers who drive frequently.

- **Most Common Vehicle Makes and Models:** BMW X5, Chevrolet Malibu, Ford Escape, Honda Civic, and Toyota Corolla are the most frequently serviced models. Understanding these common makes and models helps in inventory management and stocking relevant parts.

Make	Model	Frequency
BMW	X5	3
Chevrolet	Malibu	2
Ford	Escape	2
Honda	Civic	2
Toyota	Corolla	2

Implications and Action:
The prevalence of certain makes and models (e.g., BMW X5, Chevrolet Malibu) indicates a demand for specific parts and expertise. Stocking parts and training staff for these models can improve service efficiency. Ensure inventory includes frequently needed parts for these common car makes and models, and provide specialized training for technicians on these vehicles.
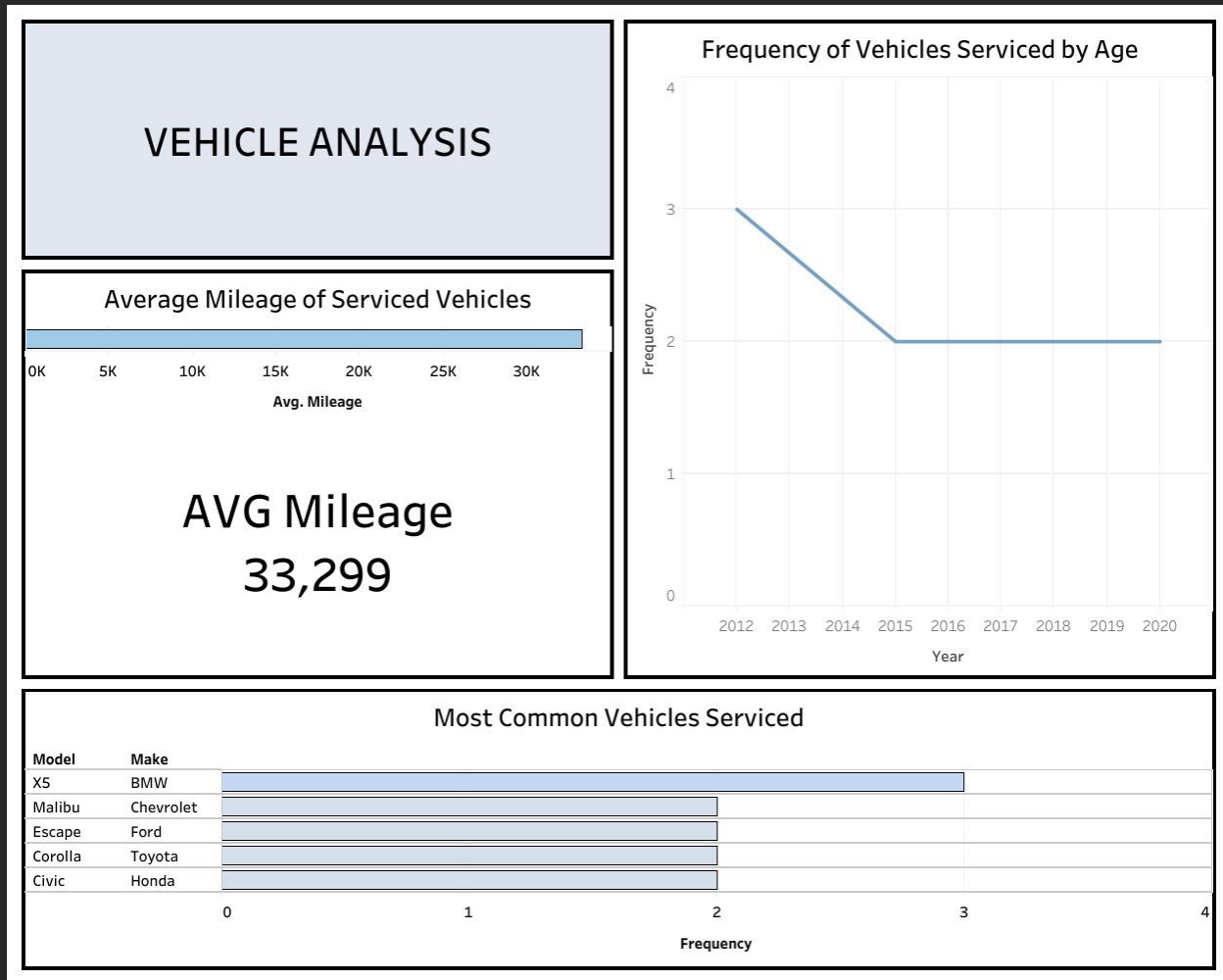
- **Distribution of Vehicle Ages:** The vehicles serviced span various years with a notable concentration around 2012, suggesting a market trend of servicing slightly older vehicles.

Year	Frequency
2012	3
2015	2
2018	2
2020	2
2016	2

Implications and Action:
Servicing slightly older vehicles (around 2012) suggests a market trend that can be capitalized on by offering targeted services and promotions for older vehicles. Promote maintenance and repair services for older vehicles, highlighting the benefits of regular servicing to extend their lifespan.

Visualization of insights derived from the Vehicle Analysis.

VEHICLE ANALYSIS

Frequency of Vehicles Serviced by Age

Average Mileage of Serviced Vehicles

AVG Mileage
33,299

Most Common Vehicles Serviced

Model	Make
X5	BMW
Malibu	Chevrolet
Escape	Ford
Corolla	Toyota
Civic	Honda

3. Job Performance Analysis:

- **Most Common Job Types:** Jobs like "Replace front CV Axel" are among the most frequently requested services. Focusing on these can enhance profitability.

Description	Frequency
Diagnose front wheel vibration	1
Replace front CV Axel	1
Balance tires	1
Oil change	1
Replace brake pads	1
Replace battery	1
Tire rotation	1
Transmission check	1
Replace air filter	1
Coolant flush	1
Replace spark plugs	1

Implication and Action:
High-demand job types like "Replace front CV Axel" are crucial for profitability. Focusing on these services can maximize revenue. Prioritize marketing and resource allocation for these high-revenue services to attract more customers and increase profitability.

- **Revenue from Each Job Type:** Jobs like "Replace front CV Axel", "Transmission check", "Replace spark plugs" generate substantial revenue ($437.50), ($300.00) and ($260.00) respectively, indicating their importance in the service portfolio.

Description	TotalRevenue
Replace front CV Axel	437.50
Transmission check	300.00
Replace spark plugs	260.00
Replace brake pads	250.00
Coolant flush	180.00
Replace battery	150.00
Balance tires	125.00
Oil change	75.00
Diagnose front wheel vibration	62.50
Tire rotation	50.00
Replace air filter	25.00

Implication and Action:
Jobs generating substantial revenue indicate their importance in profits. Ensuring these services are performed efficiently can boost overall revenue. Optimize workflows and training for high-revenue jobs to ensure they are completed efficiently and to a high standard.

- **Jobs with the Highest and Lowest Average Costs:** High-cost jobs like "Transmission check" and low-cost jobs like "Replace air filter" provide insight into pricing strategies and service prioritization.

Description	AVG_Cost
Replace front CV Axel	437.50
Transmission check	300.00
Replace spark plugs	260.00
Replace brake pads	250.00
Coolant flush	180.00

Description	AVG_Cost
Replace air filter	25.00
Tire rotation	50.00
Diagnose front wheel vibration	62.50
Oil change	75.00
Balance tires	125.00

Implication and Action:
Understanding the cost structure of different jobs helps in strategic pricing and service prioritization. Adjust pricing strategies for low-cost jobs to improve margins. Consider offering bundles or upsell opportunities for these services to increase their profitability.

Visualization of insights derived from the Job Analysis.
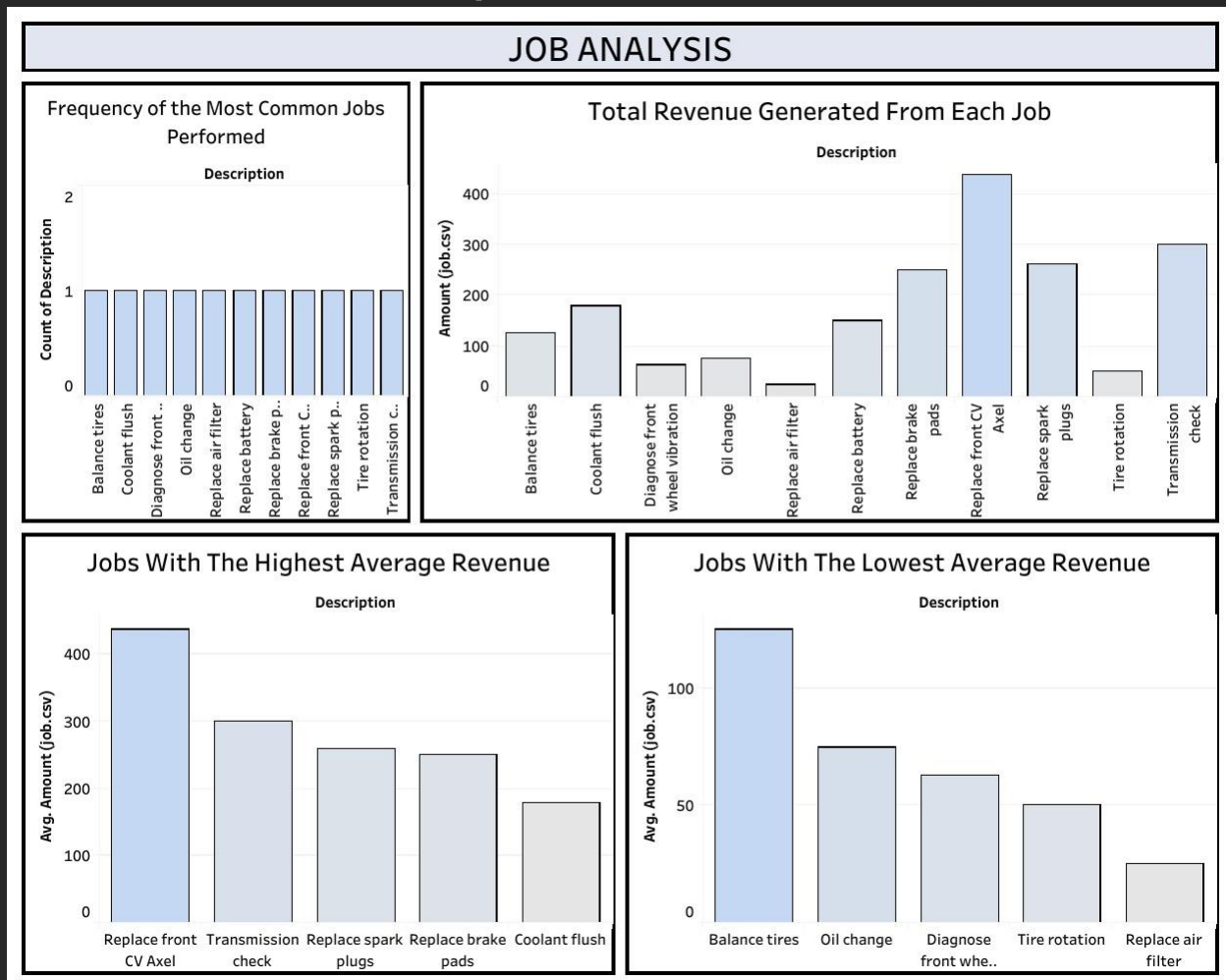
4. Parts Usage Analysis:

- **Most Frequently Used Parts:** Parts such as "Spark Plugs" and "Wheel Weights" are frequently used. Ensuring these parts are always in stock can reduce service delays.

	PartName	Frequency
▶	Wheel Weights	4
	Spark Plugs	4
	CV Axel	1
	Shop Materials	1
	Brake Pads	1

Implication and Action:
High-demand parts like "Spark Plugs" and "Wheel Weights" must be kept in stock to avoid service delays and enhance customer satisfaction. Optimize inventory levels for high-usage parts. Negotiate bulk purchase deals with suppliers to reduce costs.

- **Average Cost of Parts Used:** The average cost of parts used is $158.49, highlighting the importance of cost management in parts procurement.

	Average
▶	158.49

Implication and Action:
The average cost of parts used ($158.49) highlights the need for effective cost management to maintain profitability. Monitor part costs and implement cost-saving measures, such as bulk purchasing or alternative suppliers, without compromising quality.

- **Total Revenue from Parts Sales:** Parts sales contribute significantly to revenue ($1584.87), emphasizing the need to optimize parts inventory.
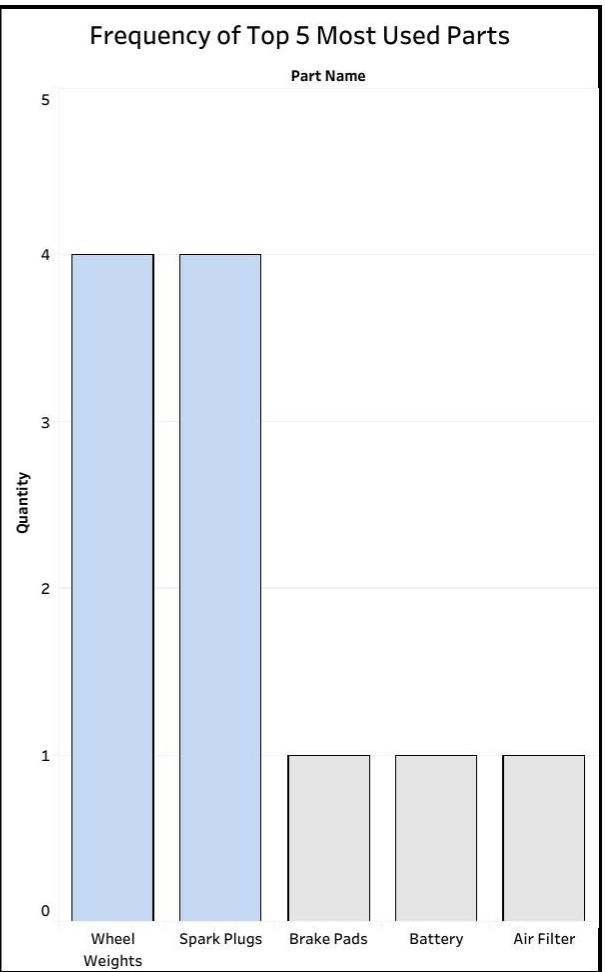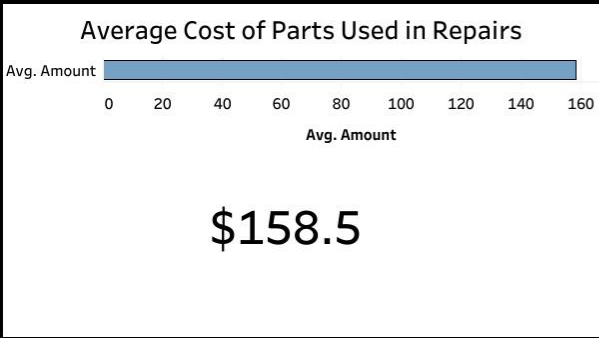
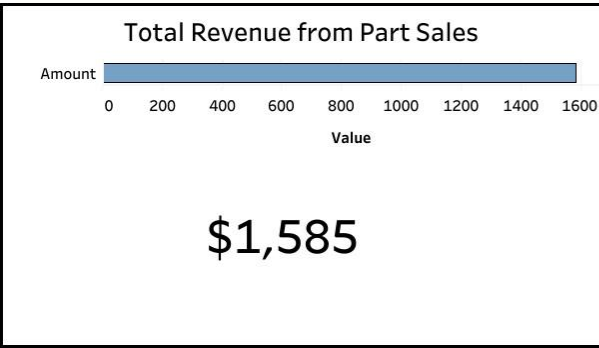|	TotalRevenue
▶	1584.87

Implication and Action:
Significant revenue from parts sales emphasizes the importance of efficient parts management. Continuously analyze parts sales data to forecast demand accurately and adjust inventory levels accordingly.

Visualization of insights derived from the Parts Analysis.

PARTS ANALYSIS

Total Revenue from Part Sales

Amount

| 0 | 200 | 400 | 600 | 800 | 1000 | 1200 | 1400 | 1600 |

Value

$1,585

Average Cost of Parts Used in Repairs

Avg. Amount

| 0 | 20 | 40 | 60 | 80 | 100 | 120 | 140 | 160 |

Avg. Amount

$158.5

Frequency of Top 5 Most Used Parts

Part Name

Quantity axis: 0, 1, 2, 3, 4, 5

Parts: Wheel Weights (4), Spark Plugs (4), Brake Pads (1), Battery (1), Air Filter (1)

5. Financial Analysis:

- **Total Revenue from Labor and Parts for Each Month:** In September, the shop generated $3924.87 in total revenue from labor and parts, showing a healthy revenue stream.

	MONTH	TotalRevenue_Labour	TotalRevenue_Parts	TotalRevanue
▶	2023-September	1890.00	2034.87	3924.87

Implication and Action:
A healthy monthly revenue stream indicates stable business operations. Plan marketing campaigns and promotions during slower months to balance revenue. Use historical data to forecast future sales and prepare accordingly.

- **Overall Profitability:** The shop's overall profit is $371.78, indicating a positive margin, but with potential for improvement.

	TotalRevenue	TotalCosts	Profit
▶	4296.65	3924.87	371.78

Implication and Action:
The shop's positive profit margin indicates a healthy business, but there is potential for improvement. Identify areas where costs can be reduced without affecting service quality.

- **Impact of Sales Tax on Revenue:** Sales tax accounts for $371.78 of the revenue, suggesting that pricing strategies need to account for tax impacts.
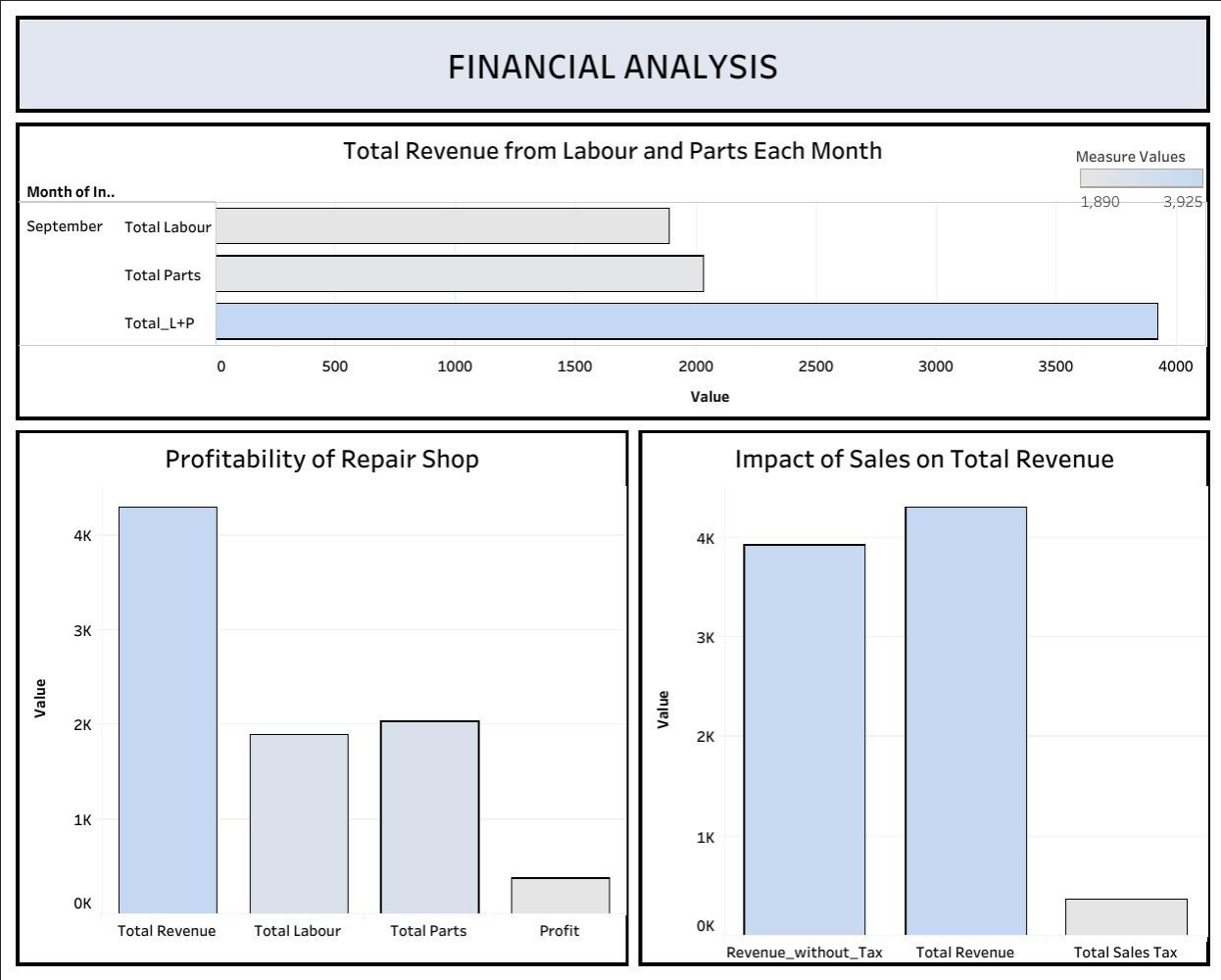
	TotalRevenue	TotalSalesTax	Revenue_Without_Tax
▶	4296.65	371.78	3924.87

Implication and Action:
The sales tax significantly impacts total revenue, indicating the need for careful pricing strategies to ensure profitability after tax. Ensure that all pricing and invoicing accurately reflect tax impacts to avoid undercharging or overcharging customers.

Visualization of insights derived from Financial Analysis.

FINANCIAL ANALYSIS

Total Revenue from Labour and Parts Each Month

Month of In..

September
- Total Labour
- Total Parts
- Total_L+P

Measure Values

1,890 — 3,925

Value: 0, 500, 1000, 1500, 2000, 2500, 3000, 3500, 4000

Profitability of Repair Shop

Value: 0K, 1K, 2K, 3K, 4K

Total Revenue, Total Labour, Total Parts, Profit

Impact of Sales on Total Revenue

Value: 0K, 1K, 2K, 3K, 4K

Revenue_without_Tax, Total Revenue, Total Sales Tax

Optimization Recommendations

Based on the analysis results, here are some actionable recommendations to optimize operations:

1. **Identifying Underperforming Services:**
   - Services like "Diagnose front wheel vibration" and "Replace air filter" have low average costs and frequency. Consider marketing these services or bundling them with other services to increase their uptake.

2. **Suggesting Parts for Higher Stock:**
   - Parts such as "Spark Plugs" and "Wheel Weights" have high usage. Ensure these parts are kept in higher stock to meet demand efficiently.

3. **Proposing Customer Loyalty Programs:**
   - High-spending customers like "Jennifer Robinson" and "David Wilson" can be targeted with loyalty programs or special offers to retain their business and encourage repeat visits.

4. **Recommending Scheduling Adjustments:**
   - Jobs like "Replace front CV Axel" and "Transmission check" generate high revenue. Allocate more time and resources to these services to maximize profitability.

Challenges

Limited Data: The analysis was conducted on a relatively small dataset, which may limit the accuracy and generalizability of the findings. More extensive data over a longer period would provide a more detailed and reliable analysis.

Summary

The analysis provided valuable insights into customer spending, vehicle metrics, job performance, parts usage, and financial metrics. Based on these insights, several optimization recommendations were made to improve shop operations, enhance customer satisfaction, and increase profitability. Implementing these recommendations can help the car repair shop achieve its business goals and maintain a competitive edge.