Report

Objective: The objective of this analysis is to explore customer-reported issues and repair records related to steering wheel components, with a focus on identifying common failure types, high-cost parts, and recurring actions. The major goal is to uncover patterns that can inform product improvements, optimize service processes, and guide warranty and maintenance decisions.

Column Analysis: The dataset comprises service and repair records primarily focused on steering wheel components. Checked the distribution of values in each column using histogram. Made bar plots to identify top 10 categories in each column. It includes both structured and unstructured fields. A detailed analysis table is included in the python script.

Data cleaning summary: Checked for null and duplicated values in Primary Key 'VIN' and 'TRANSACTION_ID'. Deleted columns having only one or zero entries. Filled null values with 'unknown', 'uncertified', or '0000'. Removed typos using textblob and manually where required. Removed whitespace and converted all strings to uppercase. Identified numerical columns and removed outliers for them.

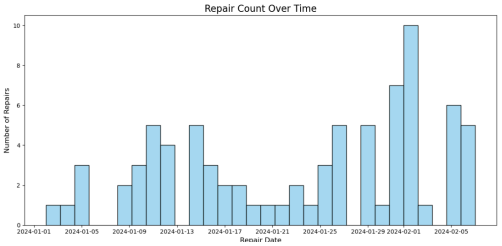
Significance for Stakeholders:

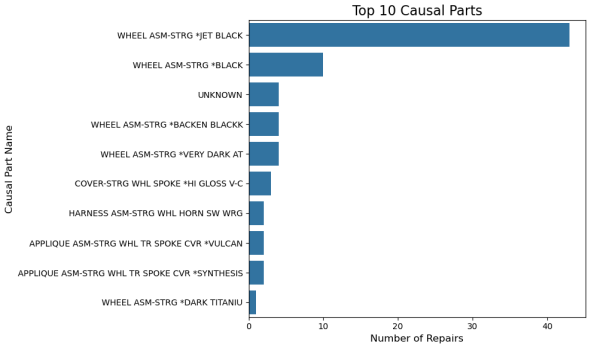
1. **Product Team Goal:** Improve vehicle design and reliability. Significance: Analyze causal parts and repair frequencies to find product design flaws. Use customer complaints and repair actions to identify recurring quality issues. Study platforms, body styles, and engine types most affected by defects.
2. **Marketing Team Goal:** Understand customer sentiment and tailor communication. Significance: Derive insights from CUSTOMER_VERBATIM to shape messaging around reliability. Target regions based on sales region codes and repair density. Identify which body styles or engine types need repositioning due to poor customer experience.
3. **Finance Team Goal:** Control warranty and repair costs. Significance: Monitor REPORTING_COST, LBRCOST, and TOTALCOST to detect high-cost repairs. Track repair age and vehicle kilometers (KM) to study cost trends over lifecycle. Optimize warranty reserves based on historical repair data.
4. **Strategy & Leadership Goal:** Drive long-term decisions around products and markets. Significance: Analyze REPAIR_AGE, ENGINE types, and PLANT data to evaluate product lifecycle and regional risks. Identify opportunities for strategic plant improvements or supply chain changes. Use the sales region and country of build/sale to guide global strategy.
5. **Data Science / Analytics Teams Goal:** Build predictive models and automate insights. Significance: Predict likelihood of breakdowns using KM, vehicle model, and repair history. Perform text mining on customer and technician verbatim to detect emerging issues. Cluster vehicles with similar failure profiles for targeted action.
6. **Customer Support & Service Goal:** Improve service quality and customer satisfaction. Significance: Use VERBATIM fields to train support teams on handling specific complaints. Identify dealers with poor performance based on repair cost/time metrics. Guide customers proactively based on last known dealer and repair history.
7. **Operations & Logistics Goal:** Improve dealer service network and logistics. Significance: Track repairing dealer location, delivery type, and region for optimizing logistics. Plan spare part stocking based on causal part trends. Evaluate dealer city performance and postal codes for service expansion planning.

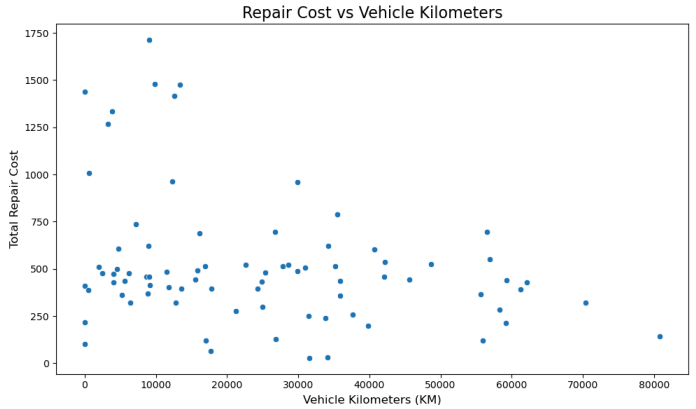
The top 5 critical columns that might be most insightful for stakeholders:

1. **REPAIR_DATE** : It will help in tracking when the repair occurred, Useful for identifying seasonal trends and failure timing.
2. **CAUSAL_PART_NM** : It reveals which part caused the failure. Critical for quality control and root cause analysis.
3. **TOTALCOST** : Shows the total cost of repair, which impacts profitability and warranty budgeting.
4. KM : Vehicle mileage at the time of repair, it can be used to analyze lifespan of parts and performance over time.
5. **GLOBAL_LABOR_CODE_DESCRIPTION** : Describes the type of labor done — useful for understanding labor trends, repair types, and service burden.

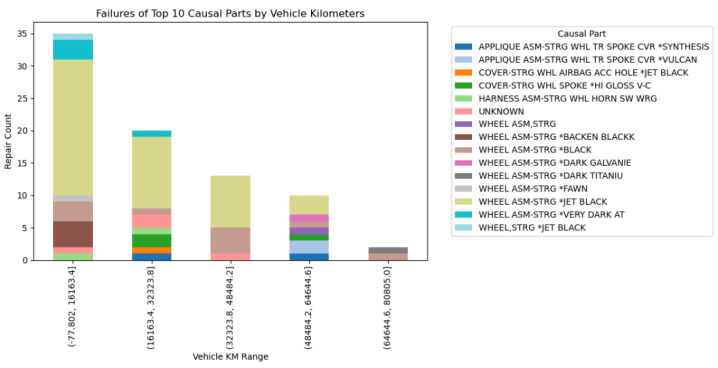
Visualizations :








```
CAUSAL_PART_NM
WHEEL ASM-STRG *BACKEN BLACKK          1276.600000
WHEEL ASM-STRG *FAWN                    963.920000
COVER-STRG WHL SPOKE *HI GLOSS V-C      784.726667
WHEEL ASM-STRG *BLACK                   631.797000
WHEEL ASM-STRG *VERY DARK AT            527.645000
WHEEL ASM-STRG *DARK GALVANIE           524.560000
WHEEL ASM-STRG *JET BLACK               500.606744
WHEEL ASM,STRG                          365.360000
WHEEL,STRG *JET BLACK                   362.690000
WHEEL ASM-STRG *DARK TITANIU            322.130000
Name: TOTALCOST, dtype: float64
```



Summary of the tags generated:

1. Components: These are physical parts or hardware elements mentioned in repair records or customer complaints.
2. Actions: These are verbs or phrases indicating a user complaint or issue.
3. Services: These are operational or technical service actions typically performed or recorded by service personnel. They reflect what was done to resolve the issue.

The tags reveal key components frequently mentioned in service records, such as the steering wheel, horn, and cover, alongside common actions like repair, replace, and inspect.

Recommendations for stakeholders on the basis of Insights:

1. From the chart of repair count over time from from early January to early February 2024, there's a noticeable spike in repair activity around the beginning of February with February 1st showing the highest number of repairs (10).

So, the stakeholders should increase staffing or resources around this period. Increase the availability of spare parts in these times. Also, the stakeholder should expect increased customer complaints at this time. Check if these peaks correlate with recent vehicle batches or platforms. Use this insight to predict future surges.

2. Many high-cost repairs occur at low kilometer ranges (under 20,000 KM). There is less variation in repair cost as the kilometers increase, suggesting newer vehicles may experience more expensive failures. Some very low-KM vehicles (even under 5,000 KM) show repair costs over 1000 units, indicating early quality or manufacturing issues.

So, it is recommended that root cause analysis should be done to find the manufacturing defects in the vehicles. Analyze which components are failing early and assess supplier quality. Consider adjusting warranty coverage. Forecast warranty reserve budgets based on this early failure trend. Encourage early service appointments within the first 10,000 KM to catch and prevent costly repairs.

3. Colored finishes like "BACKEN BLACKK", "FAWN", and "HI GLOSS V-C" significantly increase cost.

So, consider design simplification across steering wheel variants to reduce production complexity and repair cost. Negotiate bulk pricing or explore alternate sourcing for high-cost materials and finishes. Offer optional upgrades to customers rather than including expensive parts by default. Build cost-impact models for various trim levels to optimize part selection based on repair history.

4. WHEEL ASM-STRG *JET BLACK shows consistently high failure counts, especially in the first two KM bins.

So, conduct Root Cause Analysis for WHEEL ASM-STRG *JET BLACK. Redesign or material optimization for high-failure variants, especially decorative finishes (e.g., *JET BLACK, *FAWN).

Conclusion: Based on the visualizations, most repair-related features like `REPAIR_AGE`, `KM`, and `TOTALCOST` exhibit right-skewed distributions, indicating a concentration of lower values. It highlights manufacturing issues in some parts of the vehicle.