

NVH Analysis Dashboard Report

Internship Project Submission – Power BI

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Objective

This project involved building an interactive Power BI dashboard to analyze Noise, Vibration, and Harshness (NVH) metrics in vehicles. The goal was to detect patterns, identify performance issues, and provide recommendations to improve ride comfort.

Approach Overview

1. Synthetic Data Creation

- Generated a synthetic dataset in Python (1000+ rows) simulating NVH conditions.
- Included: noise levels, vibration readings, customer feedback, timestamps, and vehicle metadata.
- Intentionally added missing values, duplicates, text inconsistencies, and outliers.

2. Data Cleaning in Power BI

- Removed duplicates, filtered outliers, and corrected types.
- Replaced missing values using medians/placeholders.
- Normalized text and categorical values.
- Cleaned data exported as fact and dimension tables for modeling.

3. Data Modeling

- Built star schema with **Fact_NVH_Readings** and dimension tables for vehicle, location, and component.
- Created surrogate keys and relationships.
- Added calculated columns: **Noise_Category**, **Speed_Range**, **Harshness_Rating**.

4. DAX Measures & KPIs

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|-----------------------------|--------------------------|
| • Average Noise dB | • Average Feedback Score |
| • Total Vibration Magnitude | • Weighted Avg Noise dB |
| • High Noise Incidents | • Feedback Count |

5. Dashboard Design (2 Pages)

Page 1: NVH Performance Overview

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|----------------------------------|---|
| • KPI Cards | • Matrix – Model vs Road Surface |
| • Line Chart – Monthly Noise | • Slicers – Model, Surface, Speed, Noise Category |
| • Bar Chart – Noise by Component | • Drill-through & tooltips – Detail by Model |
| • Bar Chart – Vibration by Speed | |

Page 2: Customer Feedback Analysis

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|--|---|
| • Pie Chart – Harshness Rating | • Scatter Plot – Noise vs Vibration |
| • Bar Chart – Feedback by Noise Category | • Drill-through & tooltips – Detailed Feedback View |
| • Table – Feedback Details | |

Visual Styling and Background Design

A soft blue gradient background was designed in PowerPoint and applied across all Power BI pages for a modern executive look. Visual colors were harmonized using the following HEX codes:

- **Header icon color:** #EDF6FB
- **Bar/chart color:** #4C7C99
- **Tooltip background:** #CCDFEA

Key Insights

- Tires and Brakes showed the highest average noise (75–76 dB).
- Vibration increased by 40–60% at High Speed.
- Noise was 7–10% higher on Unknown surfaces; Wet Asphalt showed only a 1–2% increase over Asphalt.
- Poor Ride ratings correlated with high noise and vibration.
- Avg Feedback Score: 3.04/5 – showing improvement potential.

Recommendations

- Improve tire and brake dampening
- Tune drivetrain for high-speed vibration
- Evaluate NVH performance on wet and unknown surfaces
- Use feedback data for predictive maintenance
- Align NVH improvements with customer satisfaction goals

Performance Optimization

- Used DAX measures and slicers for responsiveness
- Implemented a star schema for efficient modeling
- Minimized high-cardinality columns in visuals.
- For future performance optimization, preprocessing the data in Python to reduce Power BI model load, along with creating fact and dimension tables in advance, can significantly improve scalability.
Refer: (NVH_Enhanced_Performance.py).
- This approach is also beneficial for potential migration tasks, such as transitioning to Microsoft Fabric.

Assumptions & Limitations

- Data is synthetic and simulated
- Sentiment rating is keyword-based
- No real test data used
- Trends and patterns mimic real-world conditions

Deliverables

- Power BI Dashboard: NVH_Analysis_Task.pbix
- Python Script: NVH_Enhanced_Performance.py
- This Report: NVH_Analysis_Report.docx

The synthetic dataset and the cleaned, preprocessed version have been uploaded to my GitHub repository: https://github.com/Hiteshb13/NVH_PowerBI for reproducibility and transparency.

Note: Custom tooltips were applied to key visuals: *Average Noise by Component*, *Vibration by Measurement Point*, and *Average Feedback by Noise Category*. Drill-through functionality is enabled for deep-dives by model.