Improving HRM's Paving Operations using Data Management and Analytics

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1. Problem Definition

- HRM Public Works is responsible for maintaining over 3,800 lane kms of paved and unpaved roads, valued at more than $1.6bn.
- Existing deterioration models forecast road conditions for each rehabilitation strategy over a continuous time period.
- A **laser crack measurement system** (LCMS) collects road condition data biennially, and a **pavement condition index** (PCI) value (0-100) is assigned per road.
- The project aims to improve HRM's decision-making by implementing effective data management and analysis practices.

2. Objectives

- Examine how complying with specifications affects pavement conditions.
- Evaluate data availability, accessibility, reliability, format and completeness.
- Identify paving quality measures impacting road performance.
- Improve data collection practices and availability to enable future comprehensive analysis.

3. Road Compliance

Purpose: Assessing hot mix asphalt specification's ability to distinguish between compliant and non-compliant roads.

Deliverable

- Conducted hypothesis testing on PCI difference values across the compliant and non-compliant sets.
- No significant difference in means exists, suggesting that compliance according to the specification is not a determinant of road performance.

4. Deviation Models

Purpose: Predict the difference between observed PCI performance and the values predicted by deterioration models at a specific time.

Deliverable

- Developed R script to fit several models to the provided input data.
- Used best subsets regression to identify the best set of predictor variables.
- Utilized K-fold cross validation to evaluate model performance.

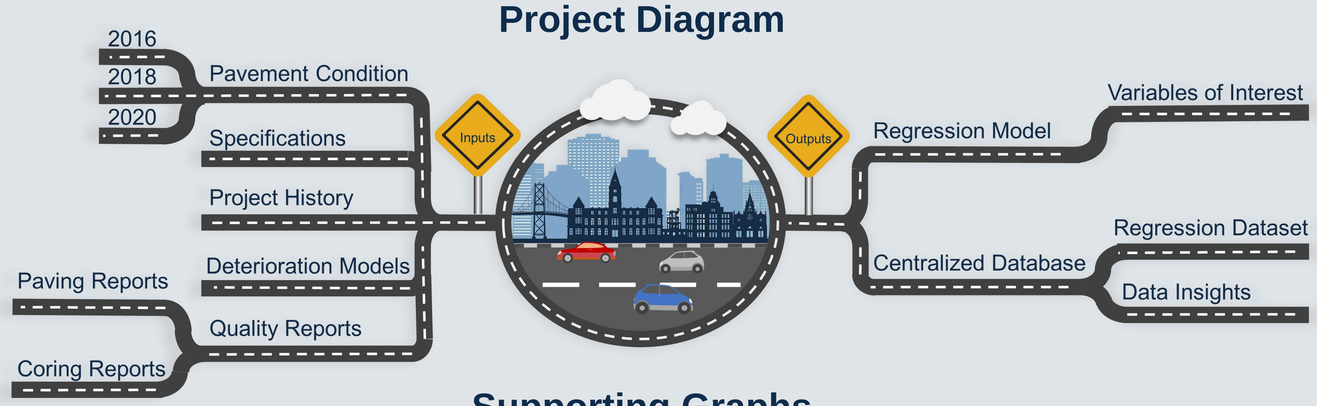
5. Centralized Database

Purpose: Prepare database to assist the transportation asset management team in addressing data availability, quality, and standardization issues for thorough analysis of the road network.

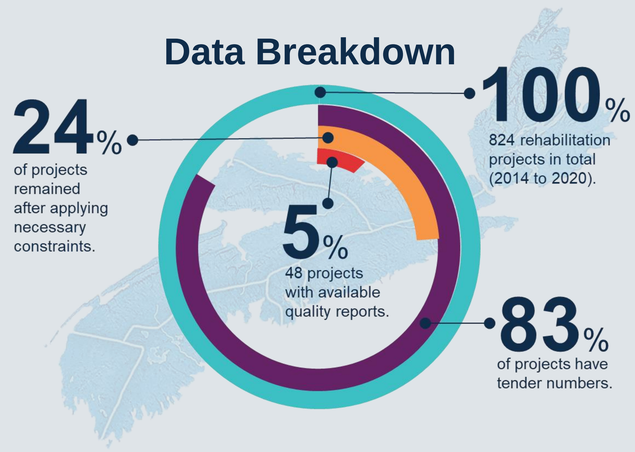
Deliverable

- Improved the quality, consistency, and completeness of available data.
- Modified paving and coring quality report structures for additional insights.
- Consolidated all available data resources within a centralized database.
- Standardized data management and developed standard operating procedures.
- Largely automated data extraction and cleanup for effective data analysis.
- Enabled extraction of road and contractor-specific insights from available data.

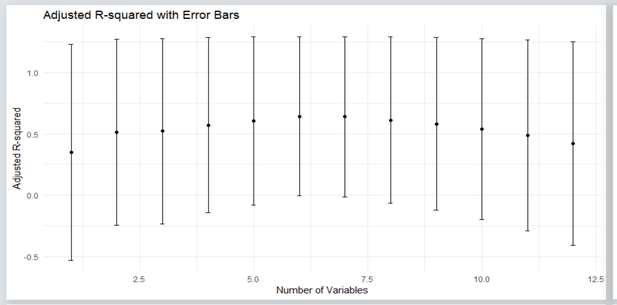
Project Diagram

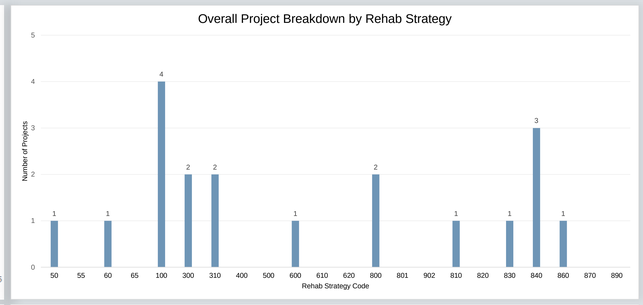


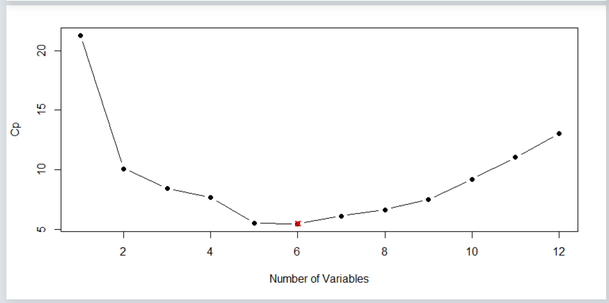
Data Breakdown

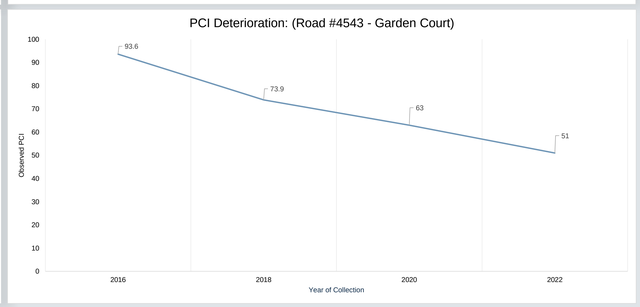


Supporting Graphs









6. Recommendations

- Introduce new PCI list file for extraction and use of project-specific values from the **Highway Pavement Management Application** (HPMA) within future data analyses.
- Apply the suggested modifications to the paving and coring reports provided by engineering consultants.
- Utilize centralized database and follow recommended practices to reduce the error and manual labour associated with the extraction, manipulation, and storage of data.
- Expand existing regression data set and utilize provided R script to select a regression model and determine the quality variables of interest.

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