# Business Case Study – Haul Truck Route Optimisation

Type of project: Data Science

Industry: Mining

## Mining Company Profile

Company Name: IronPeak Resources Pty Ltd

Mine Site Name: Mount Warragul Iron Ore Mine

Location: Pilbara region, Western Australia

## Industry Context

IronPeak Resources is a globally recognised mining company specialising in the extraction and export of high-grade iron ore. The company supplies raw materials to international markets, particularly for large-scale civil and infrastructure development. Key trading partners include government-backed construction and transportation agencies, such as Departments of Transport, as well as private-sector engineering firms involved in road, rail, and port projects.

## Mine Site Operational Overview

IronPeak Resources will showcase one of its flagship operations: Mount Warragul Iron Ore Mine, located in the mineral-rich Pilbara region of Western Australia. This open-pit site serves as a case study for operational efficiency, cost management, and the application of data-driven solutions in modern surface mining.

Mount Warragul is a high-production iron ore site utilizing traditional truck-and-shovel methods. All haul trucks on site are manually operated by trained human drivers, with no autonomous or semi-autonomous systems in use. This assumption reflects the operational reality for many mid-scale mining operations where automation has not yet been implemented due to cost, complexity, or site-specific limitations.

The mine operates 24/7 across rotating shifts, with a fleet of ultra-class haul trucks transporting ore from multiple pits to crushers, and waste rock to designated dumps. Given the significant cost of fuel, tyre wear, and equipment maintenance, optimizing truck routing and reducing unnecessary cycle times are critical business objectives.

This environment provides a realistic foundation for developing and testing data science solutions that can improve operational decision-making, reduce cost per tonne hauled, and increase overall productivity.

**About the Site**

Mount Warragul is a large-scale open-pit iron ore operation producing high-grade hematite used primarily in steel manufacturing. The mine has been operational since 2016 and plays a strategic role in meeting the company’s export commitments across Asia and the Middle East.

**Daily Operations**

* Mining Method: Conventional drill-and-blast, truck-and-shovel operations
* Haulage System: Ore and waste are transported via a fleet of ultra-class haul trucks to either crushers or waste dumps
* Processing: Ore is crushed and stockpiled before being transported via rail to Port Hedland
* Shift Pattern: Two 12-hour rotating shifts per day, 24/7 operations
* Support Infrastructure: On-site maintenance bays, dispatch centre, and ROM pad (Run-of-Mine stockpile)

**Workforce and Equipment**

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| --- | --- |
| **Category** | **Details** |
| Total Site Workforce | Approximately 430 staff and contractors, including operations, maintenance, technical services, and support personnel. |
| Haul Truck Operators | 85 trained operators responsible for operating the haul truck fleet across rotating shifts. This number supports continuous 24/7 operation while allowing for leave, training, and fatigue management. |
| Active Haul Trucks | 42 ultra-class trucks (e.g., CAT 793F), split evenly between day and night shifts. Each truck runs for 24 hours daily under a shift-based system. |
| Roster Types | FIFO 2:1 roster — two weeks on site, followed by one week off. This model ensures consistent staffing while supporting operator well-being and resting requirements. |

## Business Problem

Mount Warragul Iron Ore Mine, operated by IronPeak Resources, is currently facing rising operational costs in its haulage system — specifically related to fuel consumption, tyre wear, and equipment downtime. These issues are primarily driven by suboptimal haul truck routing, where trucks often take longer or more costly paths between loading points (e.g., Pit A and Pit B) and destinations such as crushers or waste dumps.

Due to changes in road conditions, weather impacts, and real-time traffic within the site, mine planners and dispatchers often rely on static routes or historical choices that may no longer be cost-effective. As a result:

* Fuel usage per tonne hauled is increasing
* Tyres are wearing faster than projected lifespans
* Cycle times are growing, reducing the overall number of loads moved per shift
* Operational efficiency is declining, impacting production targets and margins

With over 40 ultra-class haul trucks in daily use and multiple routing options across a complex road network, even a small improvement in routing strategy can translate into hundreds of thousands of dollars saved annually.

## Project Workflow

1. Main Objective:

Reduce operating costs by optimising haul truck routing under varying real-time conditions (traffic, weather, road quality).

KPIs (Key Metrics):

* Average cycle time per trip
* Fuel consumption per tonne moved
* Tyre wear incidents
* Loads per shift

1. Datasets

You are given the following datasets (with the assumption that some will require cleaning before exporting them to a database of your choice):

* road\_status.csv: Dynamic congestion scores and maintenance flags for each route
* routes.csv: Static road data including start/end points, distance, elevation change, and road condition
* trips.csv: Logged haul truck trips with timestamps, fuel usage, and load weight
* trucks.csv: Specifications for each haul truck, including model, fuel efficiency, and capacity
* weather.csv: Hourly weather data affecting road conditions and haulage efficiency

1. Perform EDA (Exploratory Data Analysis) and Insights

Conduct in-depth analysis of all five datasets to extract operational insights: