# OPEN PIT MINING HOUSE

## SUPPLY CHAIN ANALYTICS CAPSTONE

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# PROBLEM STATEMENT

**01**

**Complex Operations:** Mine expansion complicates tracking, hindering efficient management.

**02**

**Missed Demand:** Inefficient production fails to meet unchanged demand, disappointing customers.

**03**

**Lost Trust:** Clients lose faith as the mine's inefficiency damages its reputation.

# OBJECTIVE

**01** **Smart Live Monitoring:** Build a system to track trucks in real-time during mine operations.

**02** **Downtime Evaluation:** Analyze reasons for downtime to minimize operational disruptions.

**03** **Improved Efficiency:** Enhance overall efficiency by optimizing operations with the monitoring system.

# MINING PROCESS

- **Digger Operations:** Digging, loading ore into trucks after drilling and blasting.

- **Truck Cycle Efficiency:** Well-organized waiting, loading, hauling, and tipping.

- **Optimized Crusher Queue:** Efficiently offload ore for smooth crusher operations.

# VITAL FINDINGS FROM 46,000 OPERATIONS TO OPTIMIZE CYCLE EFFICIENCY

- A TOTAL OF 46,000 cycles analyzed, "TruckCycle" highest (22,000), "AuxMobileCycle" lowest (200).

- "LoaderCycle" has only 15 units, while others have more equipment.

- Average payload stable on weekdays (around 223 tons), lower on other days. Loading/dumping low at 5-6 and 17-18, peaks at 6-7 hours.



DAILY OPERATIONS SUMMARY : OPEN PIT MINING
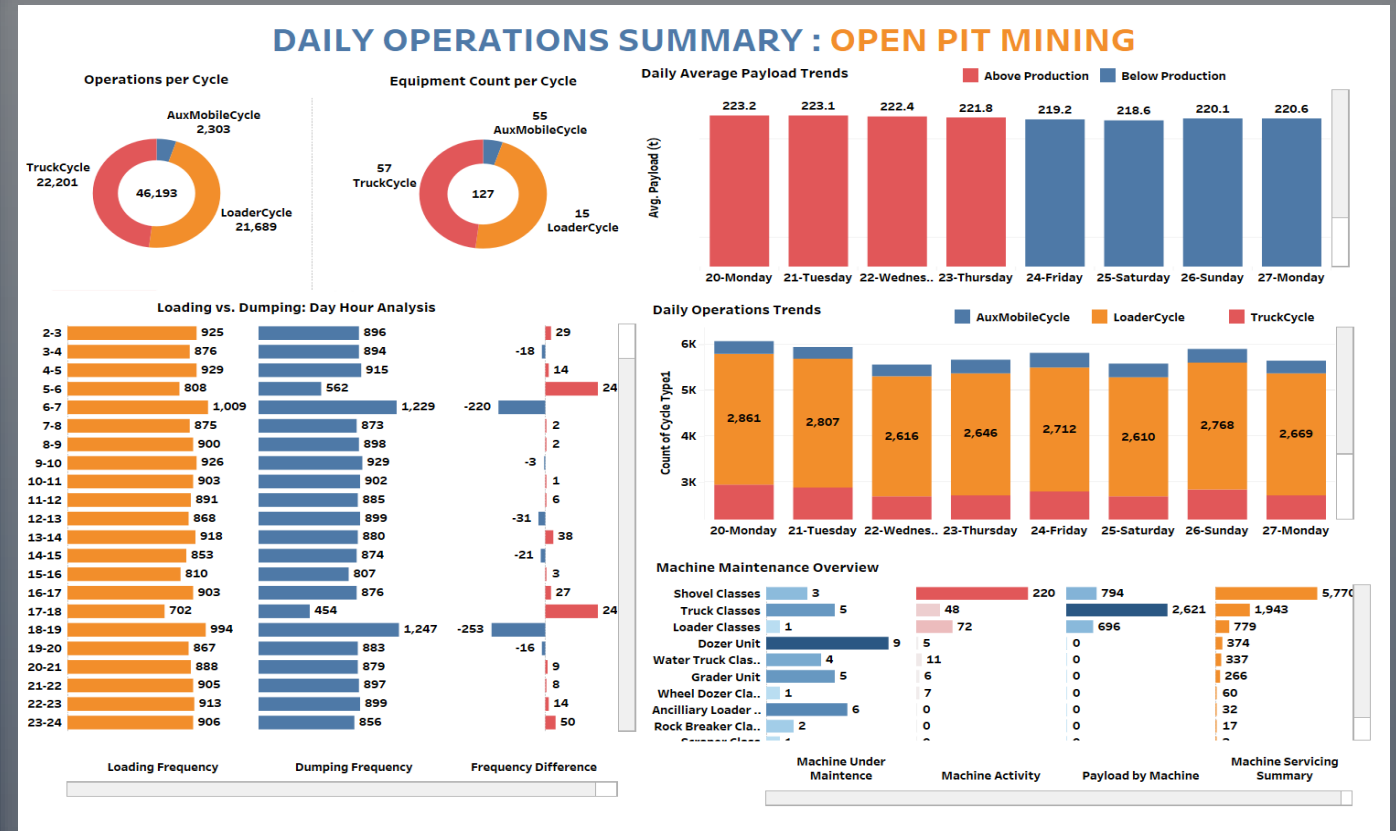
# ESSENTIAL PLAYERS & PRODUCTION TRENDS REVEALED TO MAXIMIZE MINING OUTPUT
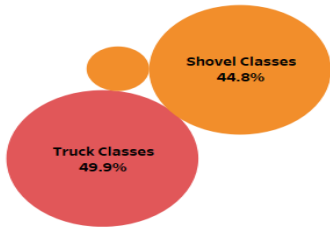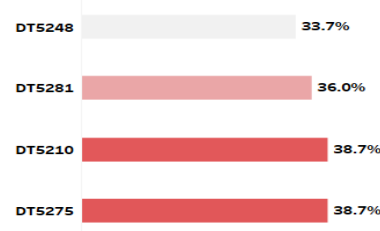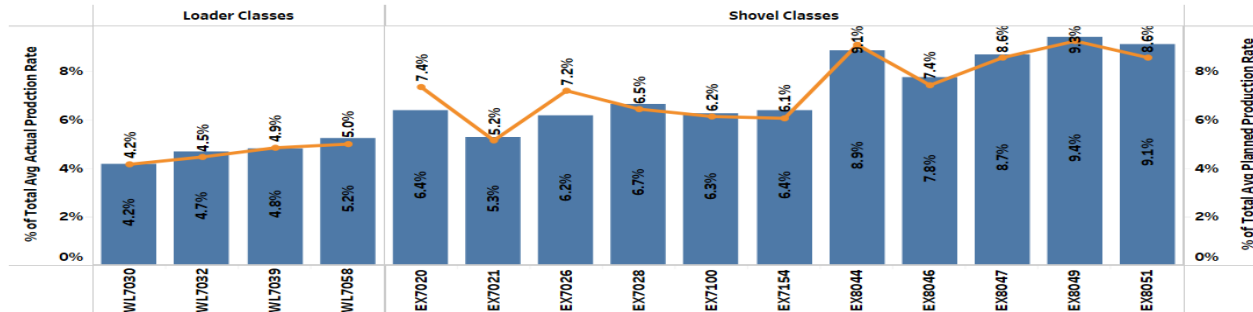


- "Truck" and "Shovel" classes contribute 50% to total production, while "Loader" class has the lowest contribution.

- Top-performing trucks (DT5227, DT5405, DT5221) achieve 56% target rate, while DT5248 and DT5281 perform poorly (33% to 36%).

- "Loader" class closely aligns with planned rate (4% to 5%), but "Shovel" class falls below average (5% to 9%).
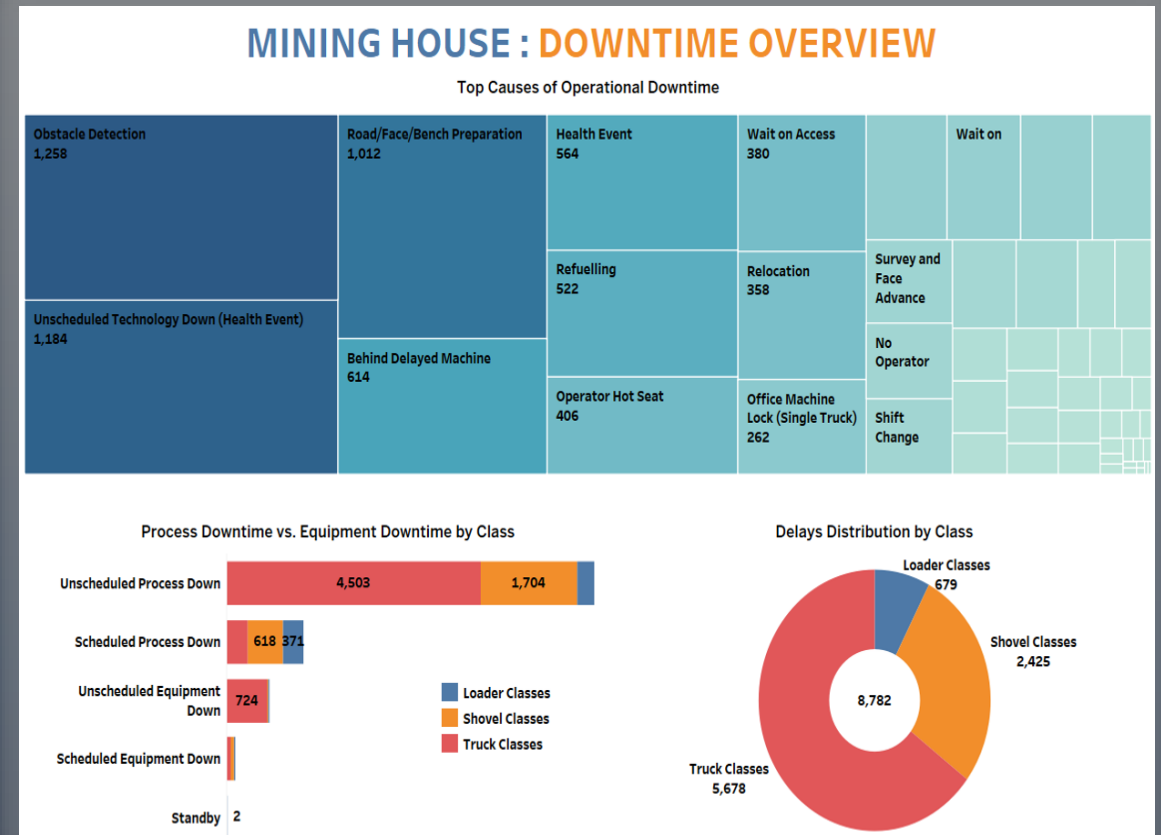
# CLASS-WISE ANALYSIS EXPLORES TOP CAUSES & IMPACT OF MINING DOWNTIME

- Leading causes of downtime: Obstacle detection (1258) and unscheduled technology downtime (1184).

- Highest downtime reasons in shovel and truck classes: Unscheduled process down delay.

- Total delays across classes: 8782. Trucks (5678) experienced the most delays, followed by shovels (2425).



MINING HOUSE : DOWNTIME OVERVIEW

Top Causes of Operational Downtime

| Obstacle Detection 1,258 | Road/Face/Bench Preparation 1,012 | Health Event 564 | Wait on Access 380 | Wait on |
| Unscheduled Technology Down (Health Event) 1,184 | Behind Delayed Machine 614 | Refuelling 522 | Relocation 358 | Survey and Face Advance |
| | | Operator Hot Seat 406 | Office Machine Lock (Single Truck) 262 | No Operator / Shift Change |

Process Downtime vs. Equipment Downtime by Class

- Unscheduled Process Down: 4,503 | 1,704
- Scheduled Process Down: 618 | 371
- Unscheduled Equipment Down: 724
- Scheduled Equipment Down
- Standby: 2

Legend:
- Loader Classes
- Shovel Classes
- Truck Classes

Delays Distribution by Class

- Loader Classes 679
- Shovel Classes 2,425
- Truck Classes 5,678
- Total: 8,782

# EFFICIENCY SPOTLIGHT: TOP-PERFORMING MACHINES & CYCLE DURATIONS IN MINING OPERATIONS EXAMINED

- **Top-performing machines EX7026, EX8044, and EX8051 demonstrate excellent overall performance with high availability (78%), performance (94%), and quality (71%) scores.**

- **Loader class machines 994H and WA1200, along with shovel class machine LBH R9400, exhibit high loading efficiency, ranging from 106.8 to 68.3.**

- **Truck class experiences the longest average cycle duration of approximately 26 minutes, while Loader and Shovel classes have shorter durations ranging from 7 to 9 minutes.**
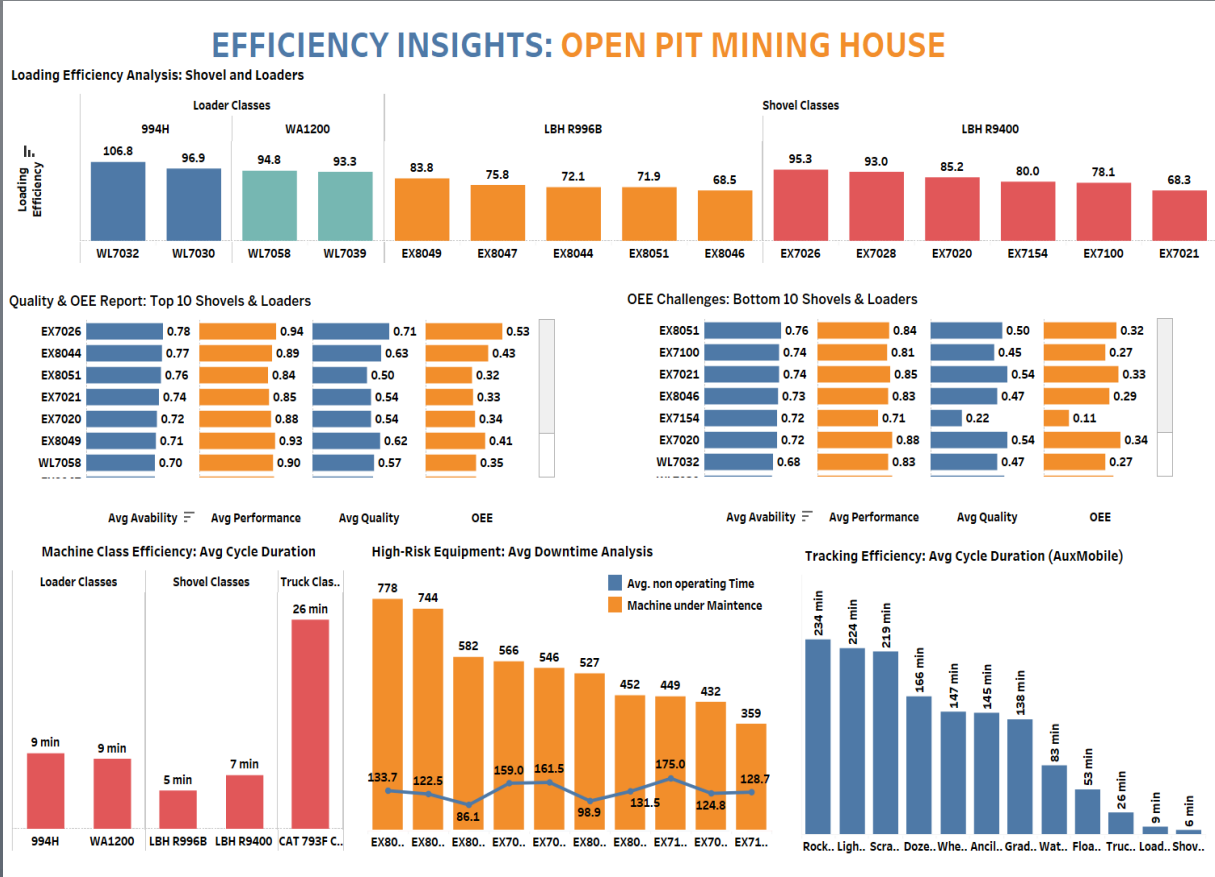
# MINING SITE EFFICIENCY: HIGH-IMPACT LOCATIONS & PRODUCTION HUBS EXPLORATION

- 12 specific locations account for around 70.38% of all visits, including DS_PC3, DS_PC1, DS_PC3_WASTE_3, DS_PC3_WASTE_2, DS_C1, DS_W5_BI12, DS_W5_BN10, DS_OB31_NORTH_2, DS_OB31_NORTH_1, DS_W3_AX11, DS_SJS_AV05, and DS_W5_BN10_2.

- 10 crushing sites refine about 77.8% of the production, including DS_PC3, DS_PC1, DS_PC3_WASTE_3, DS_PC3_WASTE_2, DS_C1, DS_W5_BI12, DS_W5_BN10, DS_W3_AX11, DS_OB31_NORTH_2, DS_OB31_NORTH_1, DS_W5_BN10_2, and DS_SJS_AV05.

- DS_PC1_ROM7 has the highest wait time of 1.64 hr/min, while DS_PC3_ROM9 has the least wait time at 0.17 hr/min.
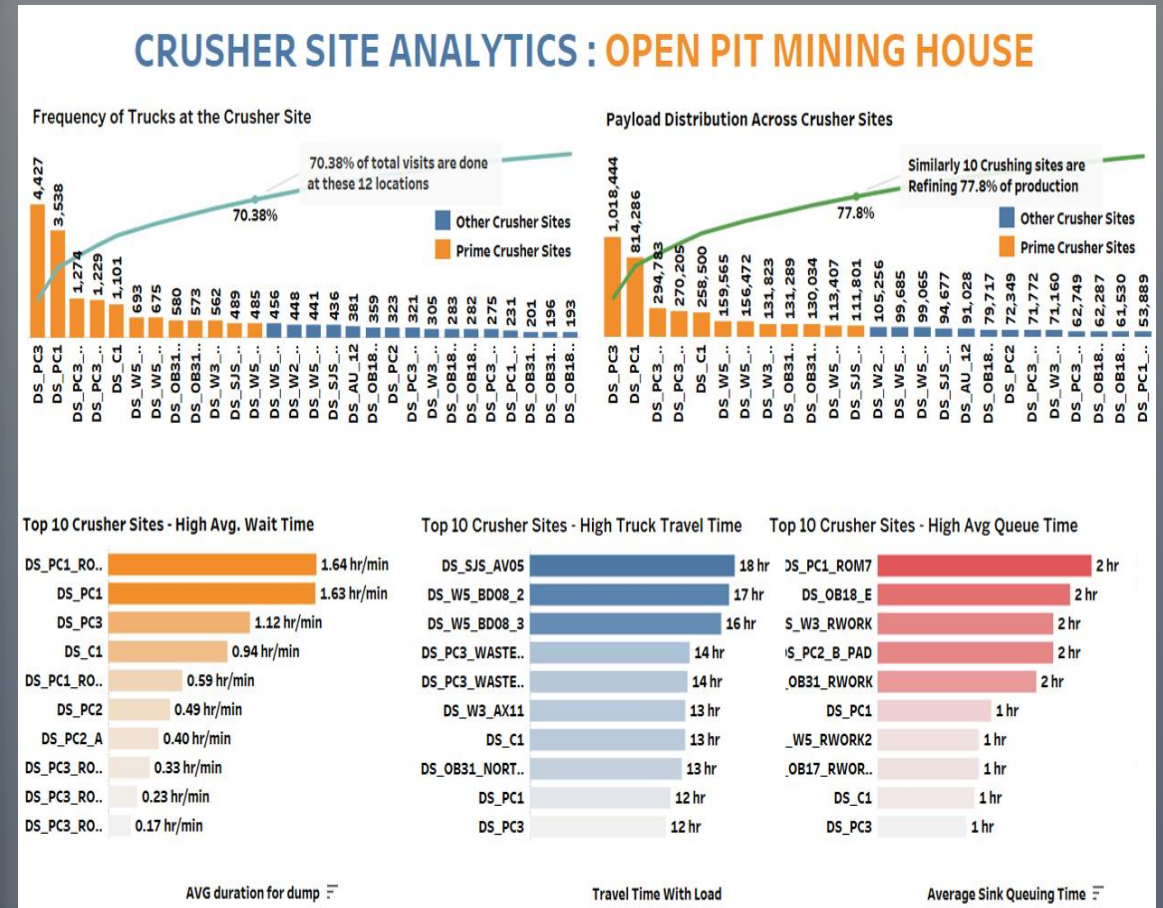
# ENHANCING TRUCK OPERATIONS BY ASSESSING MILEAGE, PAYLOAD, & MAINTENANCE EFFICIENCY

- Best-performing trucks: DT5292, DT5172, DT5272 based on their availability, performance, quality, and OEE scores of 84%, 97%, 82%, and 67%. Least efficient trucks: DT5235 and DT5223.

- DT5211, DT5296, and DT5223 excel in mileage performance at 4.68 m/s. DT5236 and DT5275 showcase high payload capacity (108K to 104K).

- Trucks DT5236 and DT5275 have the highest cycle completion, indicating operational efficiency. DT5269 and DT5308 cover an average distance of 9.5 km to 8.7 km per cycle.



TRUCK EFFICIENCY METRICS : MINING HOUSE
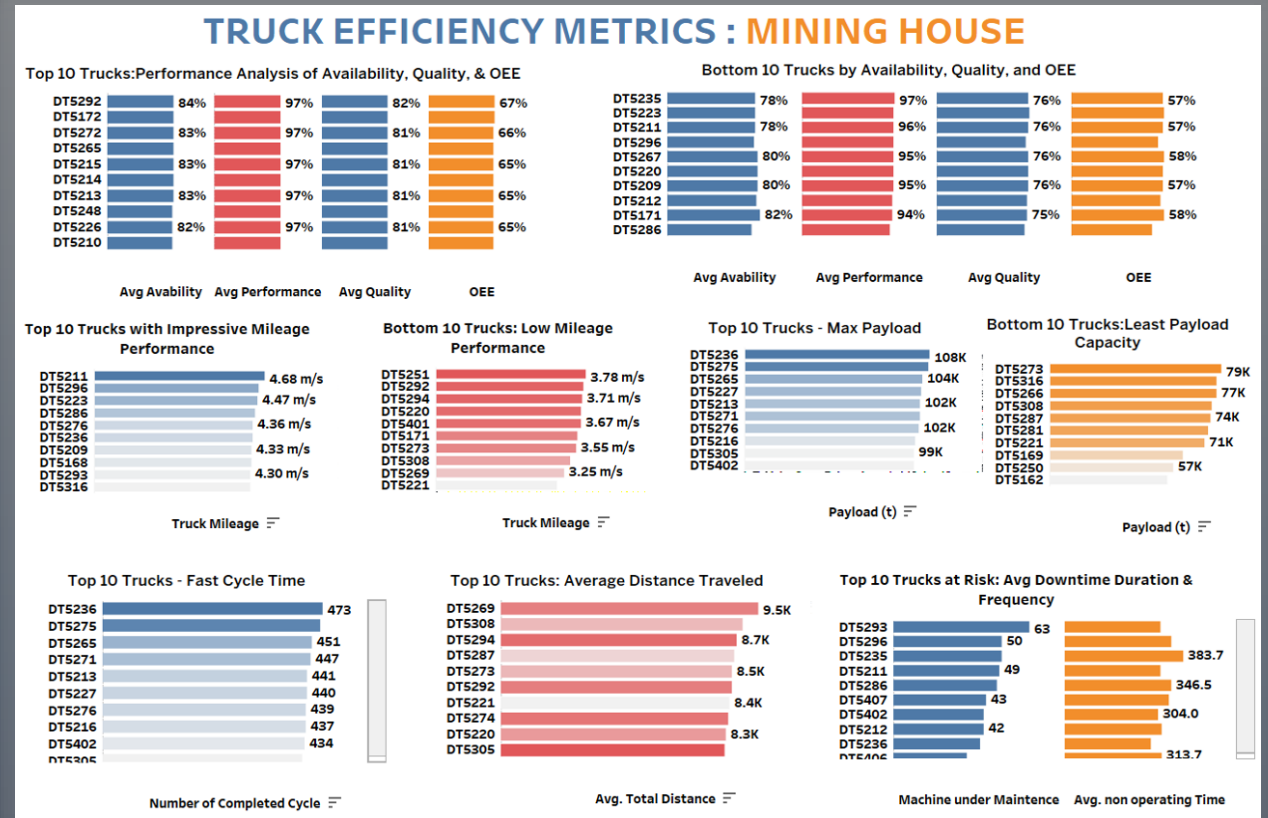
# RECOMMENDATIONS

**Optimize Cycle Efficiency:**

- Improve "AuxMobileCycle" operations with targeted optimization efforts.
- Address payload fluctuations on certain days and hours to reduce inefficiencies.
- Enhance productivity of "LoaderCycle" through focused operator training.

**Maximize Mining Output:**

- Improve performance of underperforming trucks (DT5248, DT5281) to match top performers.
- Analyze and enhance "Loader" class processes to increase its contribution to production.
- Implement strategies to improve the efficiency of the "Shovel" class.

**Enhance Truck Operations:**

- Schedule preventive maintenance for top-performing trucks (DT5292, DT5172, DT5272).
- Share best practices to improve the performance of all trucks.
- Optimize truck routes and reduce idle times during loading/unloading processes.

# APPENDIX

## DATA ASSUMPTIONS:

- Fuel used and TMPH are transformed values, and their product gives total fuel consumption, ensuring efficiency analysis.

- Total distance for truck cycles is derived from twice the Empty Travel Distance and Travel Inclined Distance, optimizing routes.

- Focus on Truck Cycles and Loading Cycles, less on AuxMobile Cycle, to identify maintenance needs based on 60% operational time.

## TOOLS USED:

- **Python:** Used for data cleaning, preparation, and quick analysis.

- **MySQL:** Employed for data analysis, storage, and executing stored procedures.

- **Tableau:** Utilized to create live interactive dashboards for data visualization.

THANK YOU!