TATA STEEL LTD
MINING DATA ANALYSIS

AN INDUSTRIAL SUMMER INTERNSHIP REPORT

Submitted by

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BONAFIDE CERTIFICATE

Certified that this project report titled "**TATA STEEL LTD MINING DATA ANALYSIS"** is the bonafide work of **"Rayaan Faiz [Ref No: VT20231028], Natalia Ahmed [Ref No: VT20231026]",** who carried out the project work under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion for this or any other candidate.

Mr. Rashid Akhtar,
Senior Manager,
Information Technology Services,
Tata Steel Limited

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Degree/ Course : B. TECH

Student Name : RAYAAN FAIZ, NATALIA AHMED

Reference Number: VT20231028,VT20231026

Title of Work **:** TATA STEEL LTD MINING DATA ANALYSIS

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Rayaan Faiz Natalia Ahmed

ACKNOWLEDGEMENT

It gives me an immense pleasure to express my profound gratitude and indebtedness to TATA STEEL Limited, Jamshedpur Jharkhand, for giving me an opportunity to be a part of the esteemed organization and enhance my knowledge by granting me the permission to undergo my Summer Internship in their reputed organization.

I owe a great debt to my mentor and supervisor, Mr. Rashid Akhtar (Senior Manager, Information Technology Services, Tata Steel Limited) who in spite of his hectic duties and responsibilities has shown genuine interest in providing necessary guidance regarding concept of the project and rendered support at all stages of the project.
I would also like the extend my sincere thanks to the entire SNTI (Shavak Nanavati Technical Institute) , Bistupur Jamshedpur, for being extremely supportive and helpful throughout the project and internship period.

Rayaan Faiz [VT20231028]
Natalia Ahmed [VT20231026]

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ABSTRACT

Tata Steel Limited has various mining fields through which it conducts operations to move hundreds of tons of various ores on a daily basis. This makes it crucial to monitor and store data of these operations and analyse it to get insights on the key performance information. The "Tata Steel Ltd Mining Data Analysis" project aims to leverage advanced data analytics techniques to uncover valuable insights from the company's mining operations. This report presents a comprehensive analysis of the mining data collected from Tata Steel Limited's mining sites, focusing on operational efficiency improvements, resource optimization, and sustainability enhancement.

The outcomes of this data analysis project have significant implications for Tata Steel Limited's mining operations. The insights obtained can guide management in making informed decisions to streamline processes, improve resource allocation, ensure employee safety, and reduce the company's environmental footprint. As the mining industry continues to evolve, harnessing the power of data-driven insights becomes paramount, and this project stands as a testament to the potential benefits of data analysis in shaping the future of mining operations.

INTRODUCTION

This chapter introduces the domain and overview of the proposed model. It gives idea what Tata Steel Mining Operations are, and how SQL, Oracle and Tableau can be used to analyse data which can provide great insights into the operations of Tata Steel Ltd.

1.1 TATA STEEL MINING

Tata Steel Limited's mining operations in Jharkhand, India, constitute a significant pillar of its integrated steel production value chain. With a rich history spanning over a century, Tata Steel's mining ventures in Jharkhand exemplify the company's commitment to sustainable resource management, technological innovation, and socio-economic development.

Extraction Sites and Ores Extracted:

Tata Steel operates prominent mining sites in Jharkhand, including the renowned **Noamundi** and **Joda** mines. Noamundi, situated in the West Singhbhum district, is one of the country's largest iron ore mines. Joda, located in the Keonjhar district of Odisha but closely tied to Tata Steel's Jharkhand operations, also contributes significantly to the company's ore requirements. These mines are instrumental in the extraction of high-quality iron ore, an essential raw material for steel production. The iron ore extracted from these sites undergoes a refining process to produce various grades of iron ore concentrates

Refineries and Factories:

The iron ore extracted from Tata Steel's mining operations in Jharkhand feeds into the company's integrated steel plants. The ore is transported to **Tata Steel's Jamshedpur Works**, a renowned steel manufacturing complex that comprises multiple units, including blast furnaces, steel melting shops, and rolling mills. These facilities use the extracted iron ore, along with other raw materials, to produce a wide range of steel products catering to diverse industries such as construction, automotive, infrastructure, and manufacturing.

Employees and Socio-Economic Impact:

Tata Steel's mining operations in Jharkhand provide direct and indirect employment opportunities to thousands of individuals. Skilled and semi-skilled workers, engineers, geologists, environmental experts, and administrative staff contribute to the smooth functioning of these mining sites. The company places great emphasis on employee safety, well-being, and skill development, nurturing a culture of continuous learning and growth.

Tata Steel's presence has a profound socio-economic impact on Jharkhand and the surrounding regions. The company's initiatives extend beyond business operations to include community development programs, education, healthcare, and infrastructure enhancement. These efforts contribute to improved living standards, skill development, and overall quality of life for local residents.

Effect of Tata Steel on India:

Tata Steel's mining operations in Jharkhand play a crucial role in supporting India's industrial growth and self-sufficiency in steel production. By ensuring a consistent supply of high-quality iron ore, Tata Steel contributes to the nation's infrastructure development and economic progress. The company's commitment to sustainable mining practices underscores its dedication to responsible resource management and environmental stewardship.

Moreover, Tata Steel's pioneering efforts in technology and innovation have a cascading effect on India's industrial landscape. The company's investments in research and development, process optimization, and digital transformation set benchmarks for the broader industry, fostering innovation and technological advancement.

In conclusion, Tata Steel Limited's mining operations in Jharkhand, India, stand as a testament to the company's enduring legacy, innovation-driven approach, and holistic contribution to societal well-being. Through its efficient extraction sites, diverse ore offerings, integrated refining processes, and positive socio-economic impact, Tata Steel continues to shape the mining and steel sectors in Jharkhand and beyond, while playing a pivotal role in India's industrial journey.

1.2 SQL

SQL, or Structured Query Language, is a powerful domain-specific language used for managing and manipulating relational databases. Developed in the 1970s, SQL has become

the standard language for interacting with database systems and plays a fundamental role in data management and analysis.

SQL enables users to perform a wide range of tasks, including creating, modifying, and querying databases. It allows for the definition of database schemas, tables, and relationships, ensuring data integrity and consistency. Users can use SQL commands to insert, update, retrieve, and delete data, making it a versatile tool for data manipulation.

SQL consists of several key components:

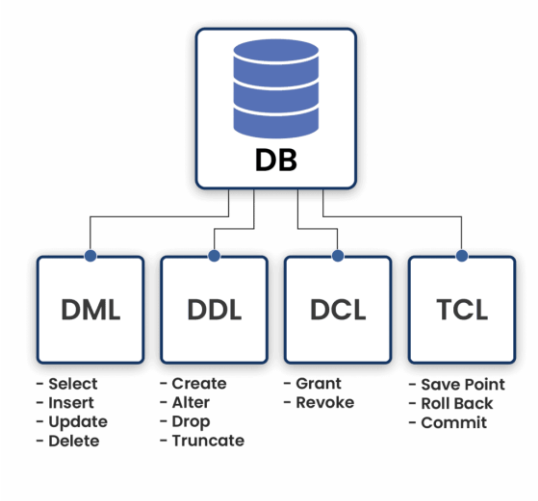

Fig. Types of SQL Commands

1)**Data Definition Language (DDL):** Involves commands like CREATE, ALTER, and DROP, which are used to define, modify, or delete database structures.

2)**Data Manipulation Language (DML):** Includes commands such as SELECT, INSERT, UPDATE, and DELETE, which allow users to retrieve, add, modify, or remove data in the database.

3)**Data Query Language (DQL):** Primarily centered around the SELECT command, DQL lets users retrieve specific data from one or more tables based on various conditions.

4)**Data Control Language (DCL):** Comprises commands like GRANT and REVOKE, which manage user permissions and access rights to the database.

SQL is a standardized language, but different database management systems (DBMS) might implement certain features uniquely. Popular DBMS platforms like MySQL, PostgreSQL, Oracle, Microsoft SQL Server, and SQLite all support SQL, with variations in syntax and functionality.

SQL's simplicity and power make it an essential tool for database administrators, data analysts, software developers, and anyone dealing with data storage and retrieval. Its ability to handle complex queries, manage large datasets, and ensure data integrity has solidified SQL's place as a cornerstone technology in modern data management and analysis.

1.3 Oracle Express

Oracle Express Edition (Oracle Database XE) is a free, entry-level version of **Oracle Database**, a powerful and widely used relational database management system (RDBMS). Oracle Express Edition is designed to provide developers, students, and small businesses with a platform to develop, test, and deploy applications without the cost and complexity associated with larger Oracle Database editions.

Key features of Oracle Express Edition include:

1)**Limited Resources:** Oracle Express Edition is designed for lightweight applications and learning purposes. It has limitations on CPU usage, memory, and database size, making it suitable for small-scale projects.

2)Ease of Use: The installation and setup process for Oracle Express Edition is relatively straightforward, making it accessible to individuals who may be new to Oracle Database or database management systems in general.

3)**SQL Compatibility:** Oracle Express Edition supports the same SQL language and tools as other Oracle Database editions, allowing developers to write and test SQL queries and statements seamlessly.

4)**Web-Based Management Interface:** Oracle Express Edition includes a web-based interface called Oracle Application Express (APEX), which enables users to create web-based applications directly within the database.

5)**Development and Testing:** Developers can utilize Oracle Express Edition to build and test applications before scaling up to more robust Oracle Database editions for production environments.

6)**Community Support:** While Oracle Express Edition does not come with the same level of official support as other Oracle Database editions, there is a community of users and resources available online to provide assistance and guidance.

Oracle Express Edition is an excellent choice for individuals and small teams looking to gain hands-on experience with Oracle Database or to develop applications with a relational database backend. While it may not offer the same extensive features and scalability as higher editions of Oracle Database, it serves as a valuable tool for learning, development, and prototyping purposes.

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1.4 Tableau

Tableau Desktop is a powerful data visualization and business intelligence tool that empowers users to transform raw data into interactive, insightful visualizations and reports. It is designed to help organizations and individuals make data-driven decisions by enabling them to explore, analyze, and present data in a visually compelling manner.

Key features of Tableau Desktop include:

1)**Data Connectivity:** Tableau Desktop supports a wide range of data sources, including databases, spreadsheets, cloud services, and more. This flexibility allows users to connect to and integrate data from various sources seamlessly.

2)**Drag-and-Drop Interface:** With an intuitive drag-and-drop interface, users can create visualizations without the need for extensive coding or technical skills. This democratizes data analysis and visualization across an organization.

3)**Interactive Visualizations:** Tableau Desktop facilitates the creation of dynamic and interactive dashboards, allowing users to filter, drill down, and explore data in real time. This interactivity enhances the ability to uncover insights and trends.

4)**Advanced Analytics:** The tool supports advanced calculations, scripting, and statistical functions, enabling users to perform in-depth analysis and predictive modeling directly within their visualizations.

5)**Customization:** Tableau Desktop offers extensive customization options for visualizations, allowing users to tailor the appearance and behavior of charts, graphs, and maps to match their specific needs.

6)**Storytelling:** Users can create compelling data stories by combining multiple visualizations into a single narrative, helping to convey insights and findings effectively to a broader audience.

7)**Sharing and Collaboration:** Tableau Desktop allows users to publish their visualizations to Tableau Server or Tableau Online, enabling easy sharing, collaboration, and access to reports across an organization.

Tableau Desktop is widely adopted by professionals in various fields, including data analysts, business analysts, data scientists, and decision-makers. Its ability to transform complex data into easily understandable visualizations empowers users to make informed decisions, drive business strategies, and communicate insights effectively. Overall, Tableau Desktop plays a pivotal role in enhancing data literacy and enabling organizations to harness the power of their data for competitive advantage.

DATA

Real-world data of Tata Steel Mining Operations between 31st May 2023 and 6th July 2023, were provided for Analysis and Visualization.

Data type:	Real World
Date Range:	31/05/23 – 06/07/23
No. of Table:	1
No. of attributes:	49
No. of values:	18410

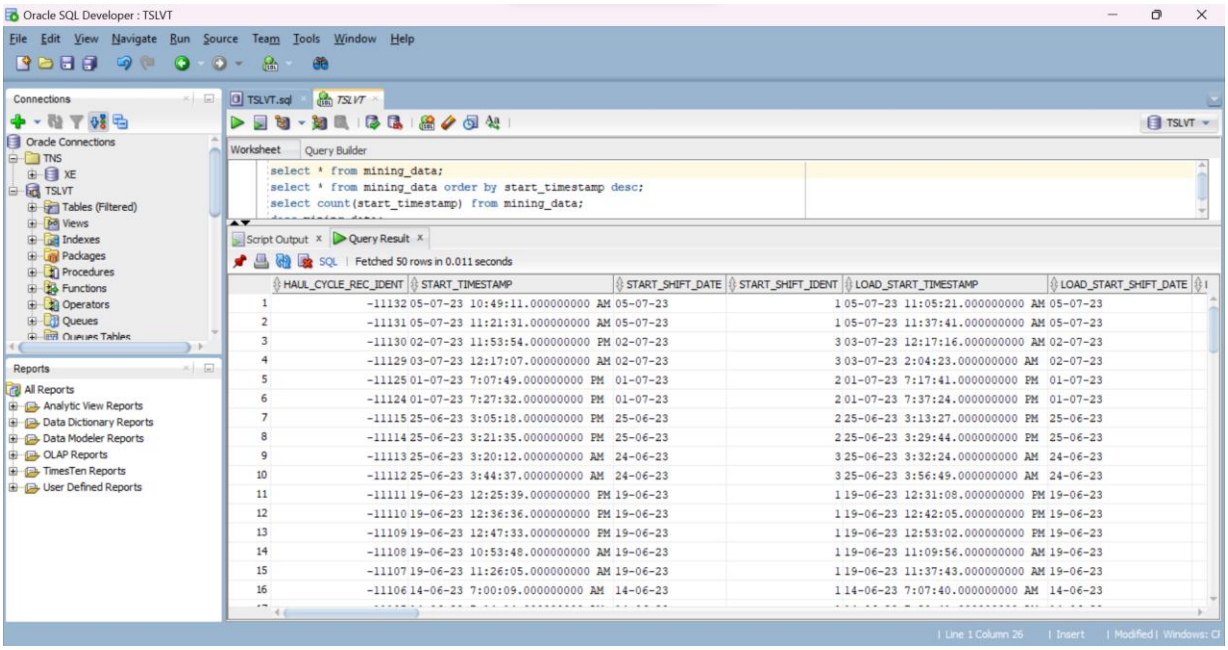
2.1 Table Details

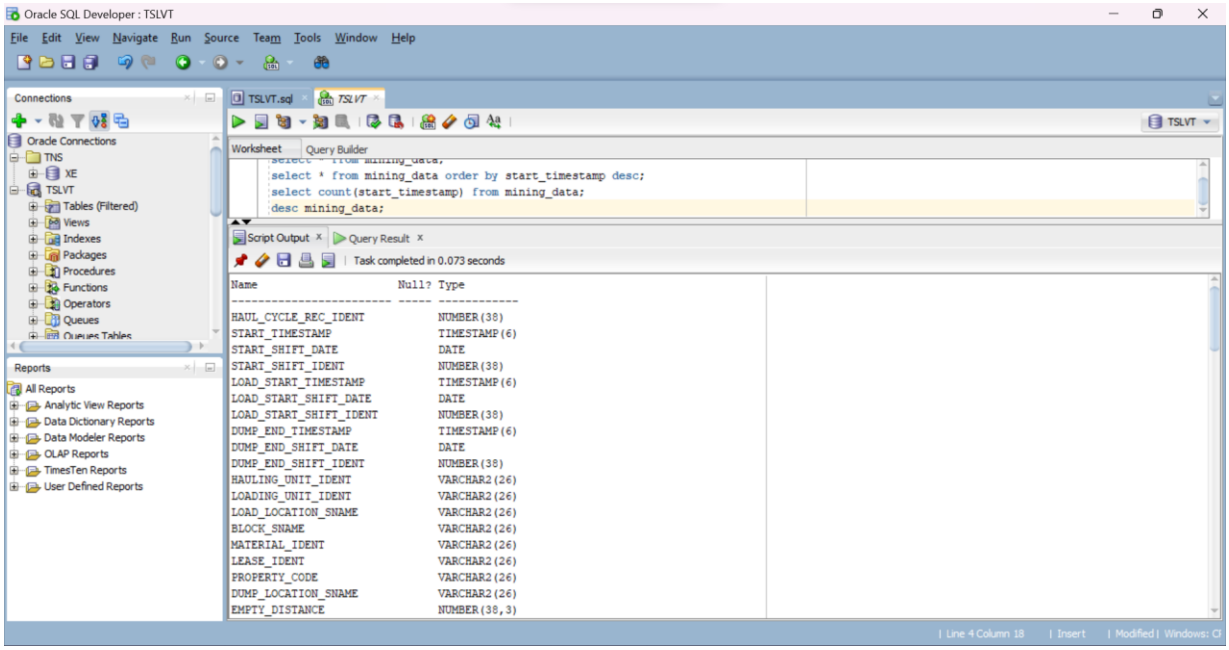
1.	**HAUL_CYCLE_REC_IDENT:**	Unique ID of Record
2.	**START_TIMESTAMP:**	Timestamp of start of shift
3.	**START_SHIFT_DATE:**	Date of the shift
4.	**START_SHIFT_IDENT:**	Shift identity (1:Morning; 2:Evening; 3: Night)
5.	**LOAD_START_TIMESTAMP:**	Timestamp of the beginning of loading
6.	**LOAD_START_SHIFT_DATE:**	Date of the loading
7.	**LOAD_START_SHIFT_IDENT:**	Shift identity (1:Morning; 2:Evening; 3: Night)
8.	**DUMP_END_TIMESTAMP:**	Timestamp of the end of dumping
9.	**DUMP_END_SHIFT_DATE:**	Date of the end of dumping
10.	**DUMP_END_SHIFT_IDENT:**	Shift identity (1:Morning; 2: Evening; 3: Night)
11.	**HAULING_UNIT_IDENT:**	Unique ID of the Hauling Vehicle
12.	**LOADING_UNIT_IDENT:**	Unique ID of the Loading Vehicle
13.	**LOAD_LOCATION_SNAME:**	Location code of Loading Site
14.	**MATERIAL_IDENT:**	Material type
15.	**DUMP_LOCATION_SNAME:**	Location code of Dumping Site
16.	**EMPTY_DISTANCE:**	Distance travelled without load
17.	**GPS_EMPTY_DISTANCE:**	GPS calculated distance travelled without load
18.	**HAUL_DISTANCE:**	Distance travelled with load
19.	**GPS_HAUL_DISTANCE:**	GPS calculated distance travelled with load
20.	**HAULING_UNIT_PAYLOAD:**	Amount (tons) of ore carried by hauling vehicle
21.	**LOADING_UNIT_PAYLOAD:**	Amount (tons) of ore carried by loading vehicle
22.	**QUANTITY_REPORTING:**	Amount (tons) of ore reported at dumping location
23.	**QUANTITY_WASTE:**	Amount (tons) of ore wasted or lost in transit
24.	**HAULING_UNIT_BADGE_IDENT:**	Unique ID of Employee driving Hauling vehicle
25.	**LOADING_UNIT_BADGE_IDENT:**	Unique ID of Employee driving Loading vehicle
26.	**PAYLOAD_TARGET:**	Daily payload target required to be met

2.2 Table Format

Attribute	Data Type
HAUL_CYCLE_REC_IDENT	NUMBER(38)
START_TIMESTAMP	TIMESTAMP(6)
START_SHIFT_DATE	DATE
START_SHIFT_IDENT	NUMBER(38)
LOAD_START_TIMESTAMP	TIMESTAMP(6)
LOAD_START_SHIFT_DATE	DATE
LOAD_START_SHIFT_IDENT	NUMBER(38)
DUMP_END_TIMESTAMP	TIMESTAMP(6)
DUMP_END_SHIFT_DATE	DATE
DUMP_END_SHIFT_IDENT	NUMBER(38)
HAULING_UNIT_IDENT	VARCHAR(26)
LOADING_UNIT_IDENT	VARCHAR(26)
LOAD_LOCATION_SNAME	VARCHAR(26)
BLOCK_SNAME	VARCHAR(26)
MATERIAL_IDENT	VARCHAR(26)
LEASE_IDENT	VARCHAR(26)
PROPERTY_CODE	VARCHAR(26)
DUMP_LOCATION_SNAME	VARCHAR(26)
EMPTY_DISTANCE	NUMBER(38,3)
OEM_EMPTY_DISTANCE	VARCHAR(26)
EFH_EMPTY_DISTANCE	VARCHAR(26)
GPS_EMPTY_DISTANCE	NUMBER(38,3)
HAUL_DISTANCE	NUMBER(38,3)
OEM_HAUL_DISTANCE	VARCHAR(26)
EFH_HAUL_DISTANCE	VARCHAR(26)
GPS_HAUL_DISTANCE	NUMBER(38,3)
HAULING_UNIT_PAYLOAD	NUMBER(38,1)
LOADING_UNIT_PAYLOAD	VARCHAR(26)
SCALE_WEIGHT	VARCHAR(26)
QUANTITY_ORE	NUMBER(38,2)
QUANTITY_WASTE	NUMBER(38)
QUANTITY_REPORTING	NUMBER(38,2)
QUANTITY_SOURCE	VARCHAR2(26)
UNADJUSTED_QUANTITY	NUMBER(38,2)
HAULING_UNIT_BADGE_IDENT	NUMBER(38)
LOADING_UNIT_BADGE_IDENT	NUMBER(38)
COST_CODE	VARCHAR2(26)
EMPTY_DISPATCH	VARCHAR2(26)
FULL_DISPATCH	VARCHAR2(26)
ELEVATION_HAUL_POSITIVE	NUMBER(38,4)
ELEVATION_HAUL_NEGATIVE	NUMBER(38,4)
ELEVATION_EMPTY_POSITIVE	NUMBER(38,4)
ELEVATION_EMPTY_NEGATIVE	NUMBER(38,4)
SOURCE	VARCHAR2(26)
ORIGINAL_SOURCE	VARCHAR2(26)
SHOVEL_LOADING_PATTERN	VARCHAR2(26)
PAYLOAD_REPORTING	NUMBER(38,1)
PAYLOAD_TARGET	NUMBER(38)
EMPTY_DISPATCH_OVERRIDE	VARCHAR2(26)

2.3 Oracle Visualization





KEY PERFORMANCE INDICATORS (KPI)

KPI is a quantifiable measure of performance over time for a specific objective. KPIs provide targets for teams to shoot for, milestones to gauge progress, and insights that help people across the organization make better decisions.

3.1 KPIs Used

The following KPIs were used in the analysis of the project:

- **i** Tonnage Handled
- **ii** TPH
- **iii** Lead Distance
- **iv** Load per Trip
- **v** Plant wise Feeding
- **vi** Quarry wise Extraction
- **vii** Material Handled
- **viii** Hauling Unit Utilization
- **ix** Loading Unit Utilization

S. No.	KPI	Definitions
1	Tonnage Handled	Equipmentwise, Operatorwise Tonnage handled Tonnage Handled Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Dimension 3: Operatorwise Dimension 4: Facewise Dimension 5: Dumplocation Dimension 6: Material Type --> Material (Dry, Wet, OB, Subgrade) Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Face, Dump Location
2	TPH	Equipmentwise, Operatorwise Tonnage per hour (TPH) TPH = Tonnage Handled/Run Hour Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Dimension 3: Operatorwise Dimension 4: Facewise Dimension 5: Dumplocation Dimension 6: Material Type --> Material (Dry, Wet, OB, Subgrade) Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Face, Dump Location

3	Hauling Equipment Utilization Hours	Hauling Equipment wise utilization hour i.e. run hour Run Hour = Diference between start time and end time Utilization % - Run Hour/God Hour Relative Utilization % - Run Hour/Available Hr Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Dimension 3: Operator Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Run Hour, Utilization %, Relative Utilization %
4	Loading Equipment Utilization Hours	Loading Equipment wise utilization hour i.e. run hour Run Hour = Diference between start time and end time Utilization % - Run Hour/God Hour Relative Utilization % - Run Hour/Available Hr Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Dimension 3: Operator Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Run Hour, Utilization %, Relative Utilization %

5	Material Handled	Types of material handled and transported per day Material Handled = Type of Material / God Hr God Hr = 8 hr for a shift and 24 hr for a day Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment
6	Plant wise feeding	Plantwise feeding Tonnage Unloading locationwise Tonnage Unloading Points = Plants, Inpit, Dumps, Stocks **Drill Down** Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Flee --> Equipment Wise Dimension 3: Mine --> Face (Load Location) Dimension 4: Dump Location **Aggregation Option** Sum, Average **To be Excluded** Extreme values (Z score >3), Negative Values --> Substitute with mean **Headers (For downloading as excel)** Month, Date, Shift, Equipment, Unloading Points

7	Quarry wise extraction	Quarry extraction Tonnage Loading locationwise Tonnage Loading Points = Quarry, Mines, Stocks **Drill Down** Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Flee --> Equipment Wise Dimension 3: Mine --> Face (Load Location) Dimension 4: Dump Location **Aggregation Option** Sum, Average **To be Excluded** Extreme values (Z score >3), Negative Values --> Substitute with mean **Headers (For downloading as excel)** Month, Date, Shift, Equipment, Unloading Points
8	Operating lead distance	Equipment wise Operator wise Lead Distance Lead distance = Distance covered by the equipment **Drill Down** Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Flee --> Equipment Wise Dimension 3: Mine --> Face (Load Location) Dimension 4: Operator Dimension 5: Dump Location Dimension 5: Material Type --> Material (Dry, Wet, OB, Subgrade) **Aggregation Option** Sum, Average **To be Excluded** Extreme values (Negative, Zero) Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Loading Points, Unloding Points

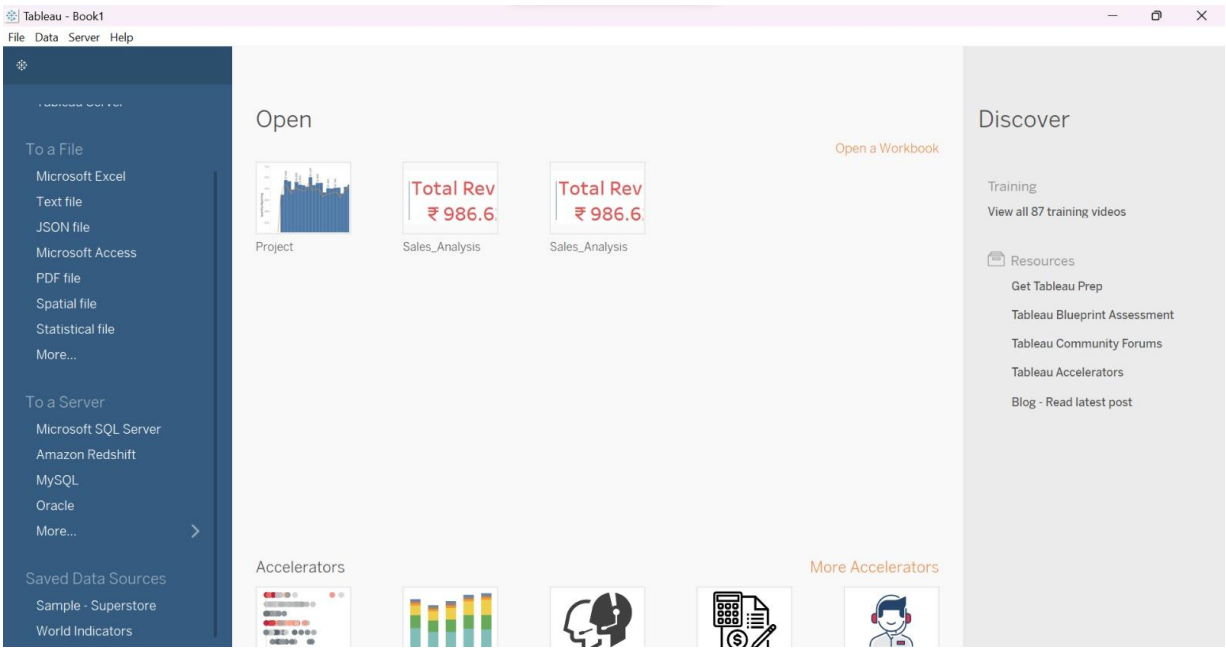
9	Load per trip	Equipmentwise, Operatorwise Diesel Load per trip Load/Trip = Tonnage/Trip Drill Down Dimension 1: Monthly --> Daily --> Shift Wise Dimension 2: Fleet --> Equipment Wise Dimension 3: Operatorwise Dimension 4: Facewise Dimension 5: Dump Location Dimension 6: Material Type --> Material (Dry, Wet, OB, Subgrade) Aggregation Option Sum, Average To be Excluded Extreme values (Z score >3), Negative Values --> Substitute with mean Headers (For downloading as excel) Month, Date, Shift, Equipment, Operator, Face, Dump Location

INTEGRATING TABLEAU AND ORACLE

4.1 To connect Oracle with Tableau, you need to follow these steps:

1) **Launch Tableau Desktop**:

Start by opening Tableau Desktop on your computer.



2) **Connect to Data**:

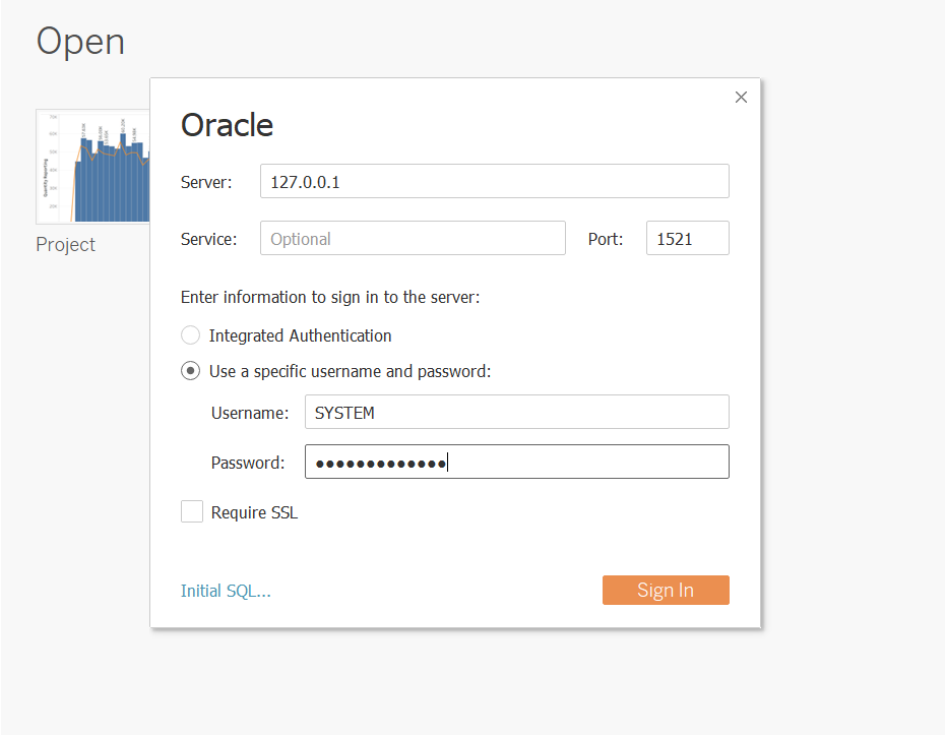
Once Tableau is open, you'll be presented with a "Connect to Data" window. You can also click on "Data" in the top menu and choose "New Data Source."

3) **Select Oracle**:

In the "Connect" pane, scroll down or search for "Oracle." Click on it to select Oracle as your data source.

4) **Enter Connection Details**:

You'll need to provide the connection details to your Oracle database. This includes the server name or IP address, port number, database name, and your credentials (username and password). You might also need to specify the connection type (TNS, JDBC).

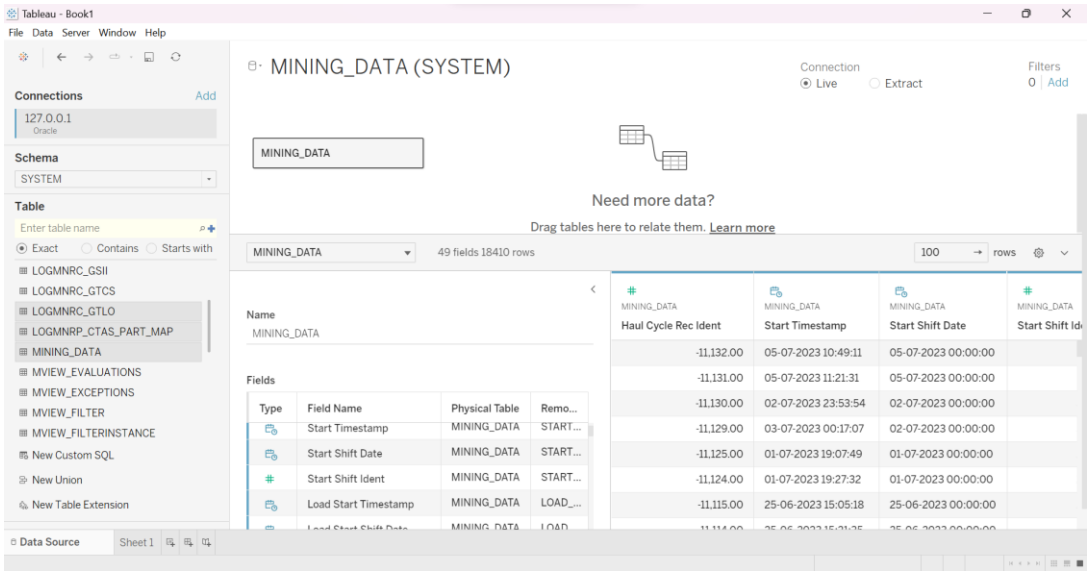


5) **Test Connection**:

After entering the connection details, click the "Test Connection" button to ensure that Tableau can successfully connect to your Oracle database.

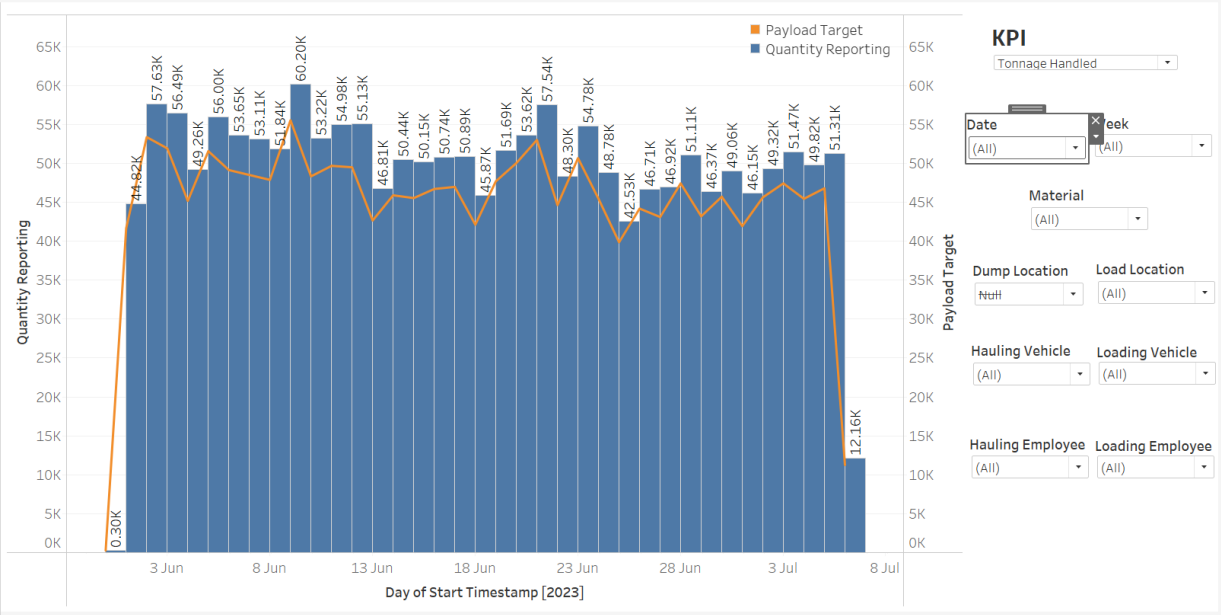
6) **Choose Data Tables or Views**:

Once the connection is established, Tableau will show you a list of available tables and views in your Oracle database. You can select the specific tables or views that you want to work with. You can drag and drop these tables or views to the canvas to start building your data source.



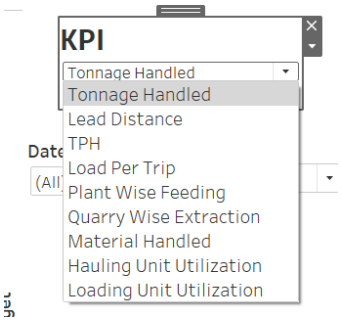
ANALYSIS

5.1 Tableau Dashboard Preview



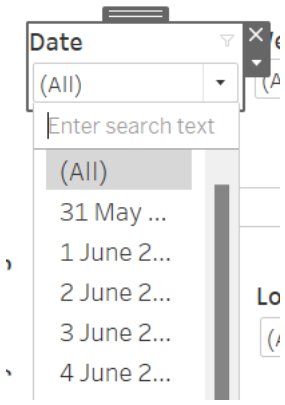
5.2 Filters:

1) KPI:



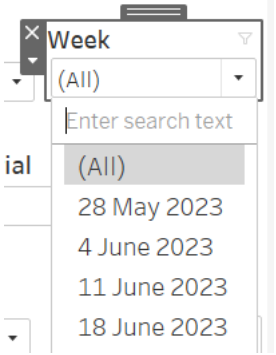
- Includes Key Performance Indicators as mentioned above upon which the charts are prepared from the data.
- The following are the used KPIs:
  - i. Tonnage Handled
  - ii. TPH
  - iii. Lead Distance
  - iv. Material Handled
  - v. Load per Trip
  - vi. Plant wise Feeding
  - vii. Quarry wise Extraction
  - viii. Hauling Unit Utilization
  - ix. Loading Unit Utilization

2) Date:



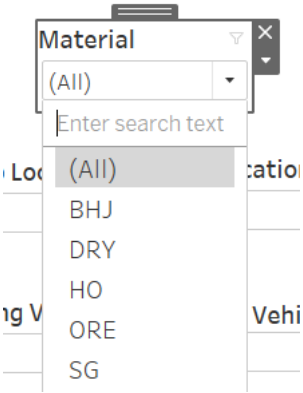
- Includes filter for particular dates between 31/05/23 - 06/07/23

3) Week:



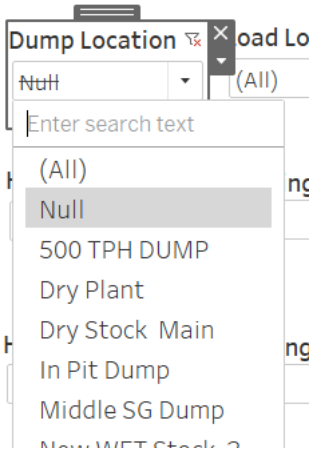
- Includes filter for particular weeks between 31/05/23 – 06/07/23

4) Material:



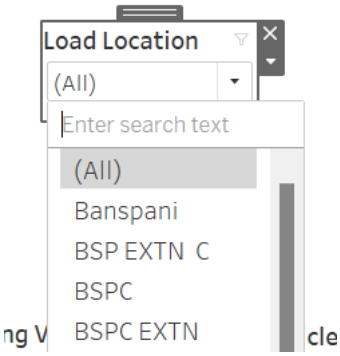
- Includes filter for the various types of materials excavated and transported

5) Dump Location:



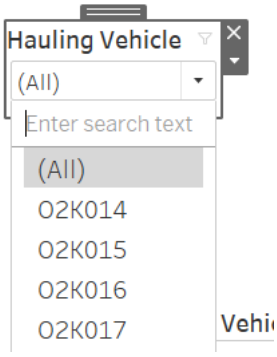
- Includes filter for the dump location of various refineries.

6) Load Location:



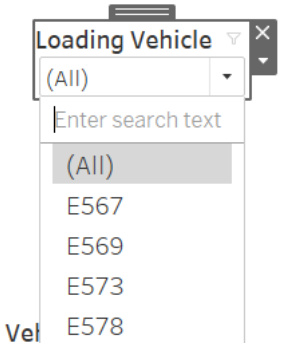
- Includes filter for the load location of various quarries.

7) Hauling Vehicle:



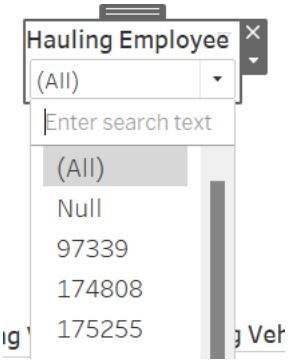
- Includes unique ID of Hauling Vehicles in work

8) Loading Vehicle:



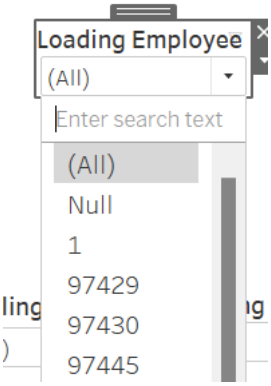
- Includes unique ID of Loading Vehicles in work

9) Hauling Employee:



- Includes unique ID of Employees handling the Hauling Vehicles in work

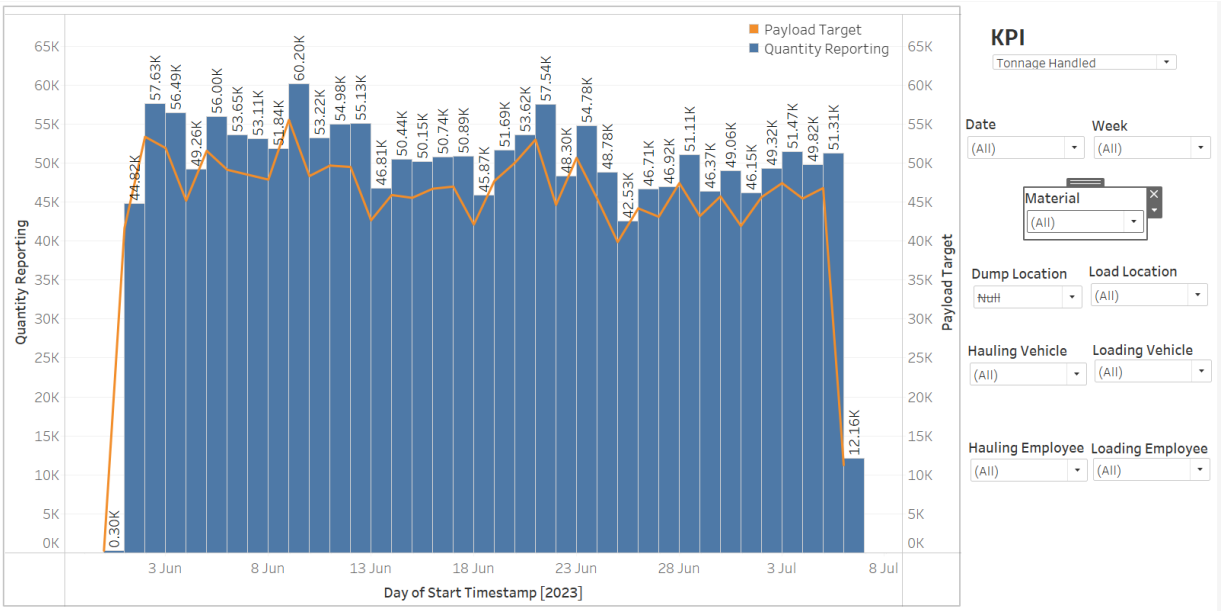
10) Loading Employee:



- Includes unique ID of Employees handling the Loading Vehicles in work

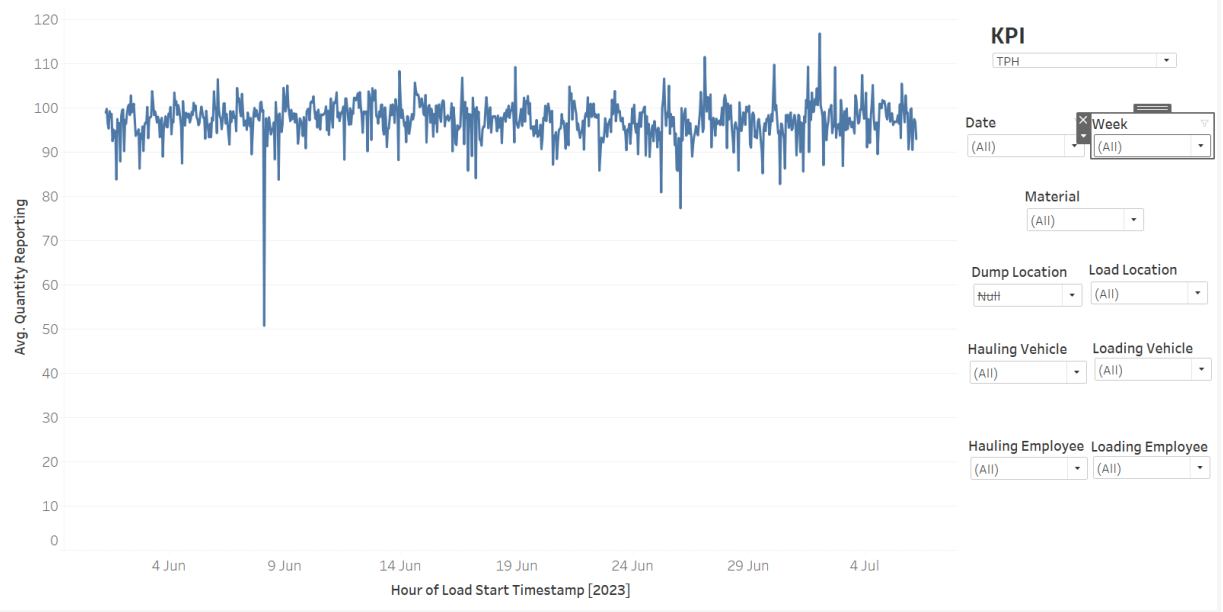
5.3 Dashboard

1. TONNAGE HANDLED



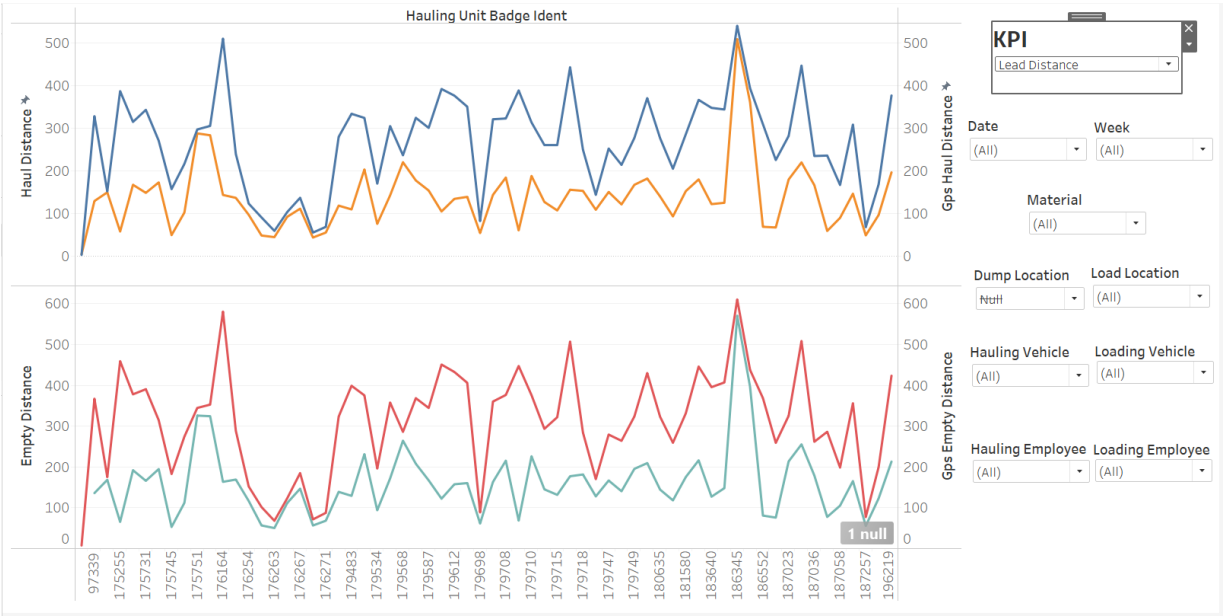
- **Legend**:
  - i. Orange Line: Payload Target for each day
  - ii. Blue Bar Chart: Daily Quantity Reported
- **Inferences**:
  Daily quantity reported target was reached and exceeded on most days.

2. TPH (TONNAGE PER HOUR)



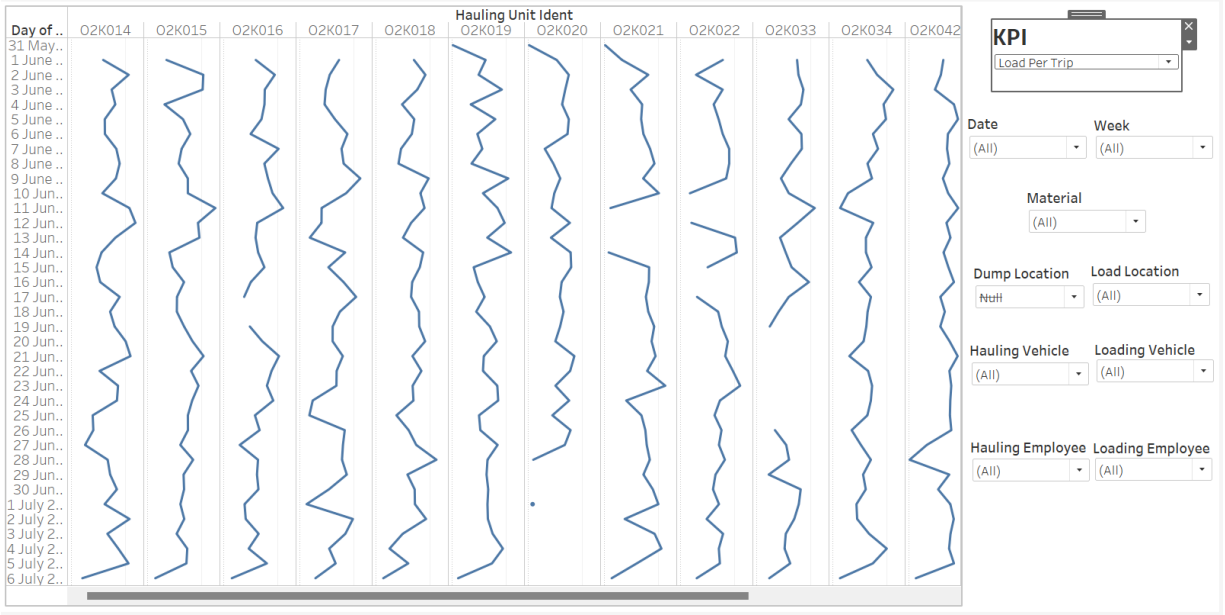
- **Legend**:
  Blue line chart: Average quantity reported per hour
- **Inferences:**
  i. Average quantity reported per hour has been steady between 90-100 tons.
  ii. Sharp fall in TPH observed on 8th June to 50 tons per hour but can be considered as an outlier.

3. LEAD DISTANCE



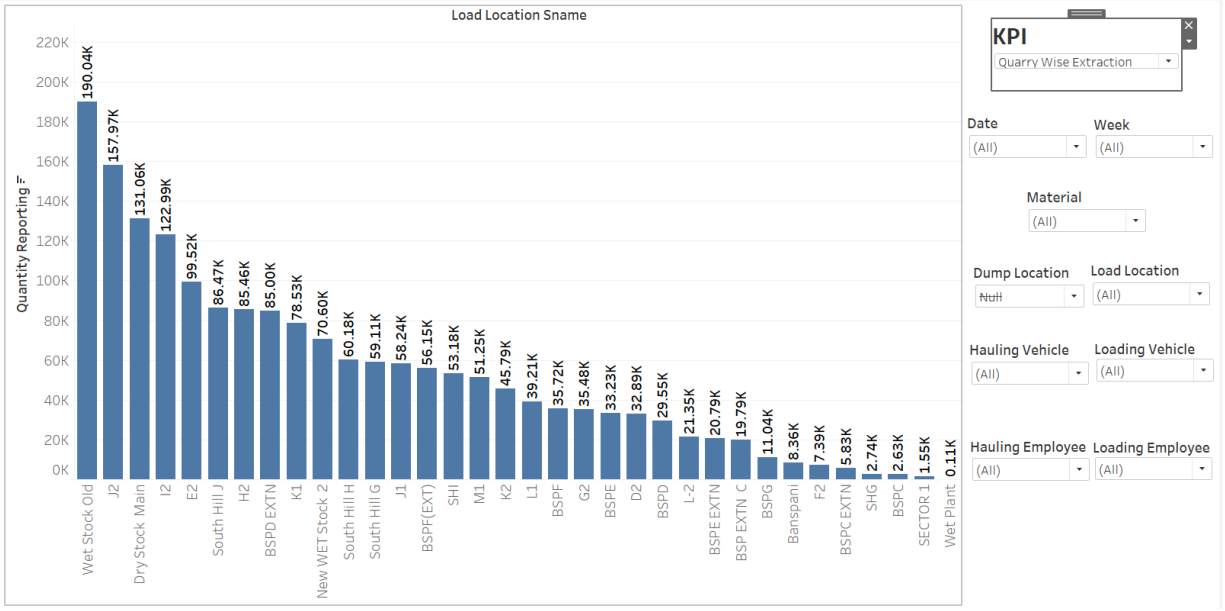
- **Legend:**
  i. Blue: GPS calculated haul distance of hauling vehicle
  ii. Orange: Reported haul distance of hauling vehicle
  iii. Red: GPS calculated empty distance of hauling vehicle
  iv. Green: Reported empty distance of hauling vehicle
- **Inference:**
  i. Stark difference in data reported and gps calculated data of haul and empty distance
  ii. Vehicles have travelled more empty than with the goods almost every day.

4. LOAD PER TRIP



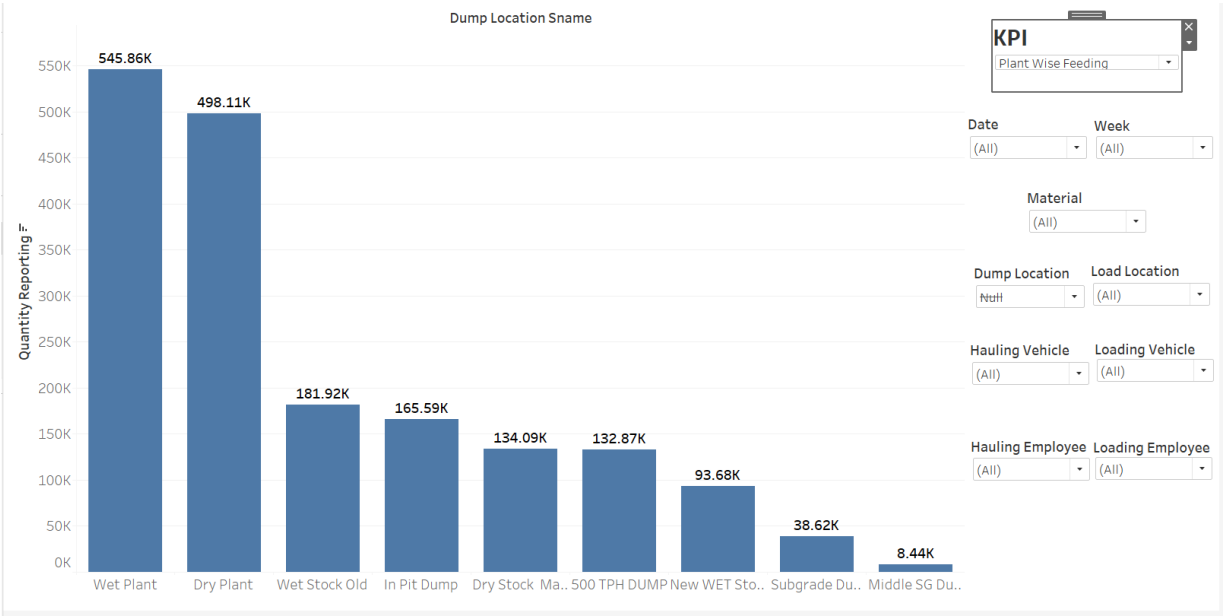
- **Legend:**
  - i. Blue: Quantity reported by each vehicle everyday
- **Inference:**
  - i. Hauling vehicles reported 3500 ± 700 tons on an average every day.
  - ii. Certain vehicles like **O2K020** and **O2K033** were absent from work for more than a week.

5. QUARRY WISE EXTRACTION



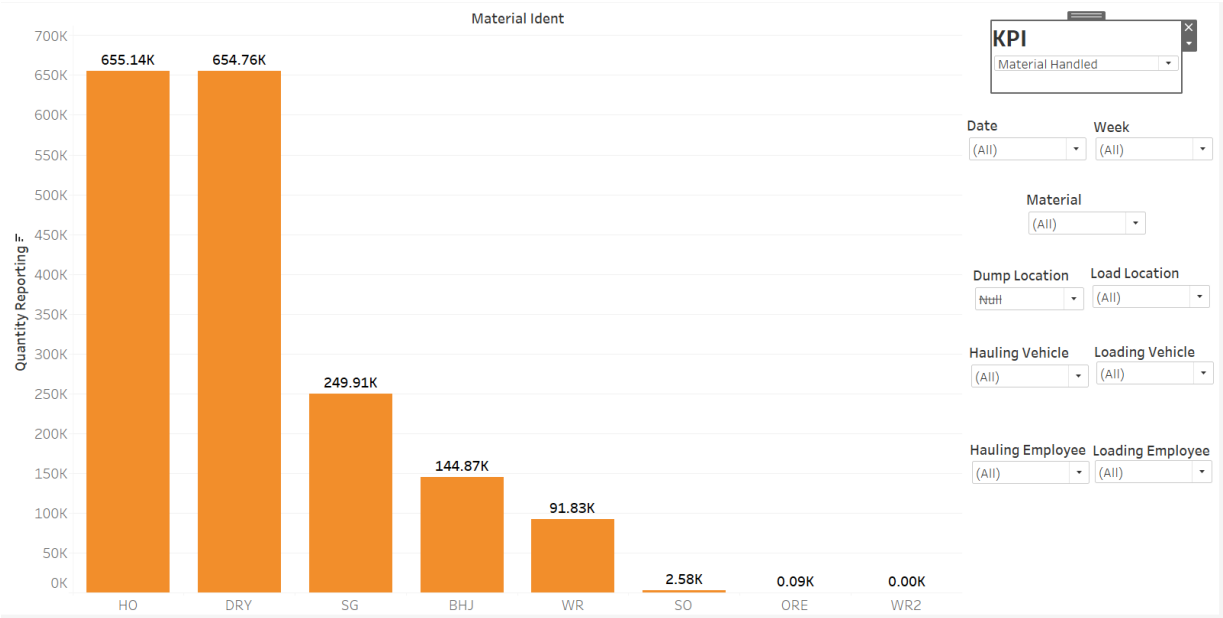
- **Legend**:
  i. Blue: Tons of ore quantity reported
- **Inference:**
  ii. In the time duration of 36 days, **WET STOCK OLD** reported highest transfer of ore quantity (*190k tons*) followed by **J2 SITE** (*157.9k tons*) and so on
  iii. **SHG, BSPC, SECTOR 1**, and **WET PLANT** showed negligible outputs throughout the time frame.

6. PLANT WISE FEEDING



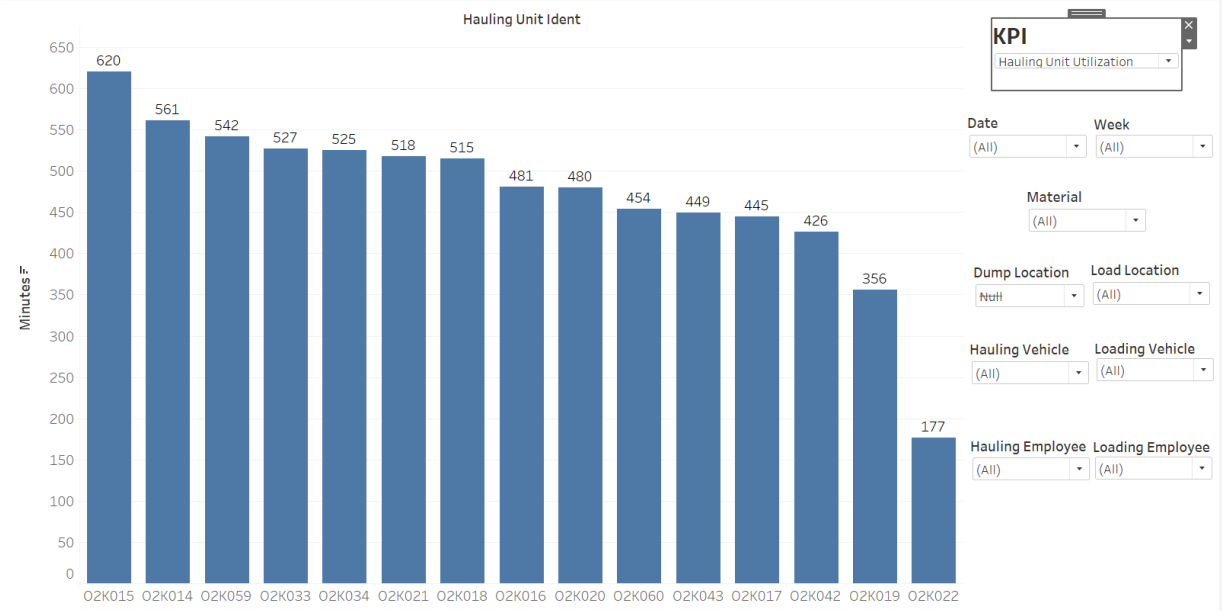
- **Legend:**
  i. Blue: Tons of ore quantity reported
- **Inference:**
  i. In the time duration of 36 days, **WET PLANT** reported highest receiver of ore quantity (*545.86k tons*) followed by **DRY PLANT** (*498.11k tons*) and so on
  ii. **MIDDLE SG DUMP** showed lowest received quantity of ore (*8.44k tons*)

7. MATERIAL HANDLED



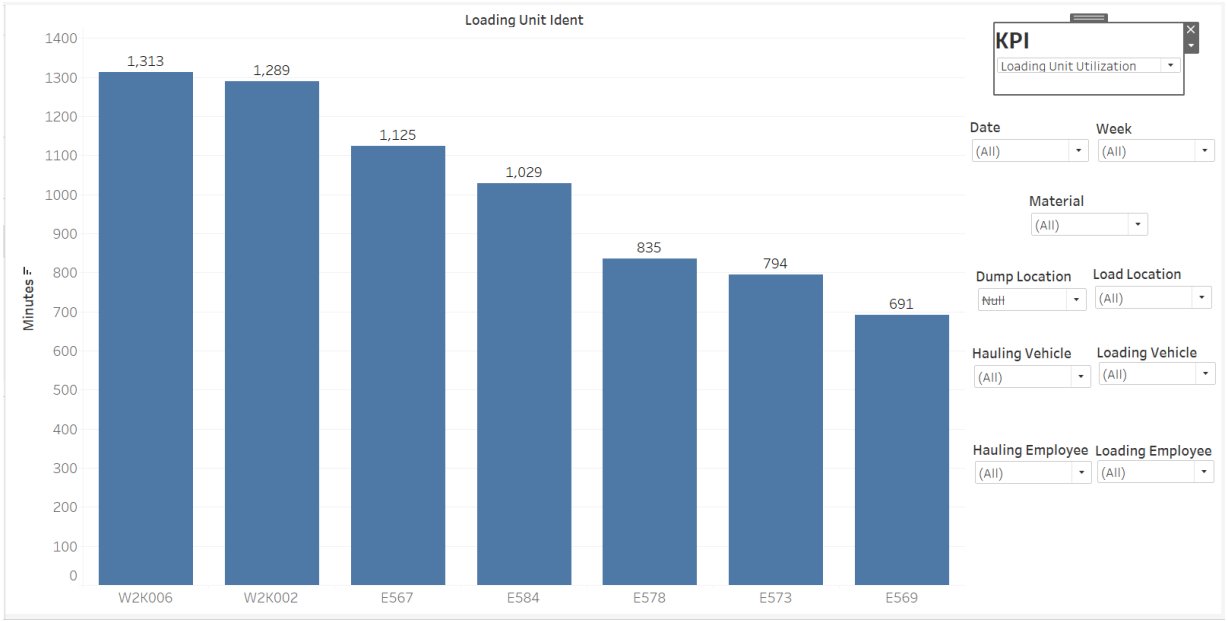
- **Legend:**
  - i. Orange: Tons of ore quantity reported
- **Inference:**
  - ii. In the time duration of 36 days, Material **HO** and Material **DRY** was handled the most at *655.14k* tons and *654.7k* tons respectively
  - iii. Material **SO**, Material **ORE** and Material **WR2** were the least dealt with materials with negligible quantities of **WR2** and *<1*k ton quantities of **ORE**

8. HAULING UNIT UTILIZATION



- **Legend:**
  - Blue: In the span of 36 days, number of minutes in use of the hauling vehicles
- **Inference:**
  - All vehicles show average of *500* minutes used but vehicle **O2K022** shows significantly lower usage.
  - However, in terms of handling materials, **O2K022** has handled sufficient amount of quantity even after being available for low hours.

9. LOADING UNIT UTILIZATION



- **Legend:**
  - Blue: In the span of 36 days, number of minutes in use of the loading vehicles
- **Inference:**
  - No abnormalities detected in the availability of loading vehicles
  - Vehicles **W2K006, W2K002, E567** and **E584** have been used to handle most of the materials.

CONCLUSION

In conclusion, the Mining Data Analysis project conducted for Tata Steel has provided valuable insights and actionable intelligence that can significantly impact the company's operations, decision-making processes, and overall performance. Through the application of advanced data mining techniques, a comprehensive exploration of the company's diverse datasets was undertaken, yielding a deeper understanding of critical variables and trends.

The project's findings unveiled hidden patterns, correlations, and anomalies within Tata Steel's data ecosystem. By harnessing predictive modeling, clustering, and classification algorithms, the project identified factors influencing production efficiency, supply chain dynamics, and market demand. This newfound knowledge empowers Tata Steel to optimize its processes, enhance resource allocation, and align its offerings with market trends.

Moreover, the project's visualizations and interactive dashboards have transformed complex data sets into comprehensible visuals, fostering a data-driven culture within the organization. Stakeholders can now intuitively explore and interpret data, facilitating quicker and more informed decision-making.

The successful collaboration between data analysts and domain experts was pivotal in contextualizing the findings within Tata Steel's operational landscape. This synergy ensured that the insights generated were not only statistically robust but also aligned with real-world feasibility and strategic relevance.

As Tata Steel continues to embrace data-driven strategies, the outcomes of this mining data analysis project serve as a foundation for continuous improvement and innovation. The project's implications extend beyond immediate gains, setting a precedent for leveraging data analytics to adapt, grow, and remain competitive in a dynamic global industry.

In essence, the mining data analysis project marks a significant milestone in Tata Steel's journey towards harnessing the full potential of its data assets. By unearthing insights, fostering informed decision-making, and promoting innovation, the project paves the way for Tata Steel to forge a more resilient and prosperous future.

REFERENCES

ITEM	Links
Dataset	Link
KPI	Link
Tableau Workbook	Link