
GWF
GEOSPATIAL WORLD FORUM
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IIT (ISM)

TEXMiN

Geospatial Knowledge Infrastructure for Mining 5.0

TEXMiN – IIT (ISM) Dhanbad

- SMART • SAFE • SUSTAINABLE • SCIENTIFIC
- SOCIAL

(5S) MINING

सत्यमेव जयते
Department of Science & Technology
Govt. of India

National Mission on Interdisciplinary Cyber Physical Systems
NM-ICPS

Legacy that Inspires the Future

भारतीय प्रौद्योगिकी संस्थान
भारतीय खनि विद्यापीठ
धनबाद

IIT ISM INDIAN INSTITUTE OF TECHNOLOGY INDIAN SCHOOL OF MINES DHANBAD

Economic scenario and mineral sector implication in India

- Mineral Concessions Grant : Auctions
- DMF: District Mineral Foundation (DMF), the long-time grievance of the people affected by mining
- NMET: National Mineral Exploration Trust for incentivizing regional and detailed exploration
- Mining Leases for 50 years - Existing leases deemed extended.
- Stronger penal provisions for checking illegal mining - Higher penalties up to 5 lacs per hectare of the area and jail term up to 5 years
- Mineral (Evidence of Mineral Content) Rules & Mineral (Auction) Rules
  - hand-holding support for the implementation of auctions of mining leases/PLs-cum-MLs
  - Handholding Post Auction: Post Auction Mining and Approvals Facilitator (PAMCAF) has been rechristened into Transparency, Auction Monitoring & Resource Augmentation (TAMRA)
- Use of Space Technology for curbing illegal mining issues

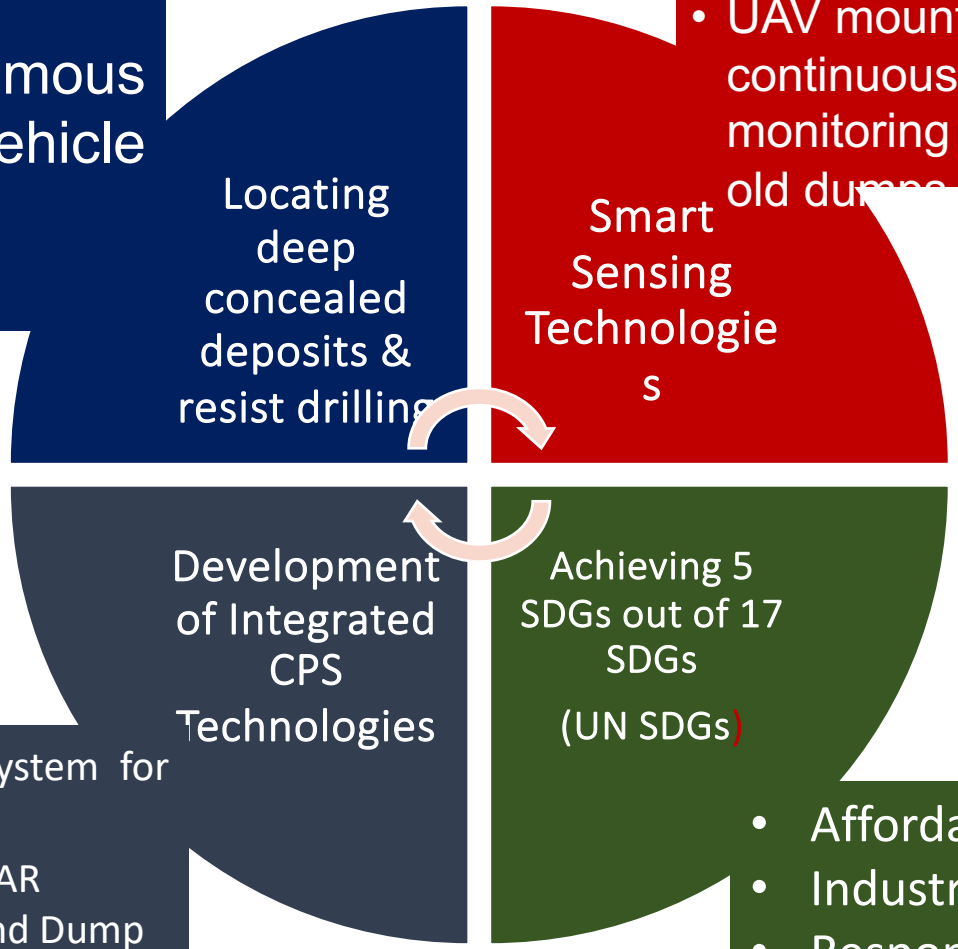
Star Rating of Mines

Economic, Environmental and Social Benefits of enhancing Sustainability in Mining by Star Rating System

- Lower the cost of exploration through pattern matching, predictive analytics and computer Vision systems (AR & VR)
- Development of an autonomous multirotor unmanned aerial vehicle for geophysical survey

- AI based Predictive Maintenance of Mining Equipment for improving productivity
- Spatial Visualization using AR, VR and LIDAR Technologies
- UAV mounted sensors for real time continuous and precise movement monitoring of waste dump, active as well as old dumps

OBJECTIVES OF GEOSPATIAL TECHNOLOGY



DELIVERABLES

- Robotic based Surveillance and Evacuation System for Underground Mine Safety
- Development of a low-cost AI/ML portable RADAR system for Monitoring and prediction of Rock and Dump Slopes failure in Open Cast Mines
- Machine learning algorithms for accurate extraction of features in mine areas and characterization of geo-hazards

- Affordable and Clean Energy
- Industry, Innovation
- Responsible Consumption and Production
- Life on Land
- Partnerships to achieve the goal

Role of Geospatial Technology in Mining Value Chain

Exploration and Geology

- Exploration Drilling
- Logging & Coring
- Sampling & Analysis
- Geological Report

→ Resource Model 

Mine Design and Production Planning

→ Mine Design 

→ Design Optimization 

- Technical: Ramp Widths, Wall Angles, Bench Heights
- Financial: Mining Costs, Process Costs, Admin Costs

→ Long term production planning 

→ Medium term production planning 

Mine operation

Drilling & Blasting 

→ Excavation & Loading 

→ Transportation   

↓

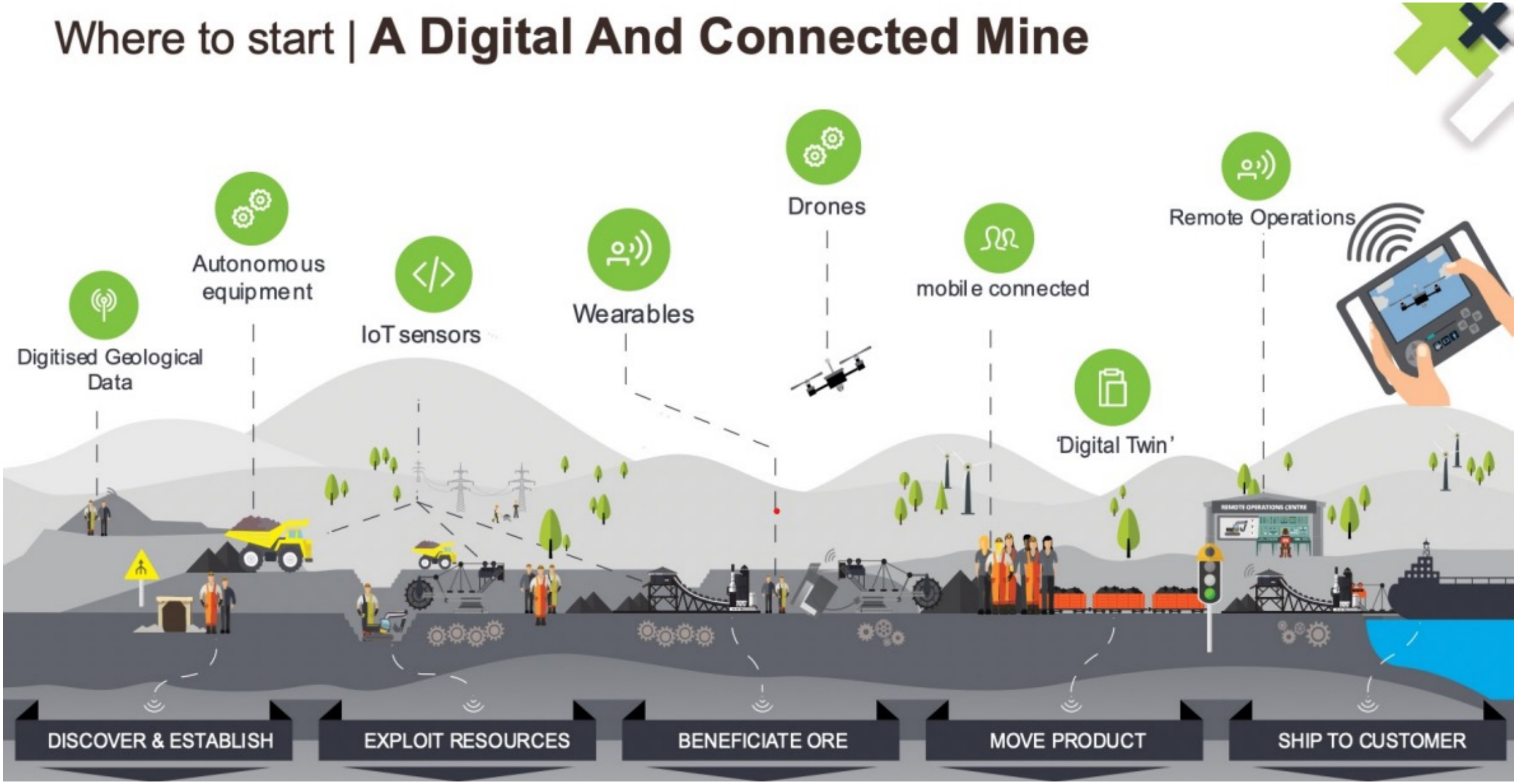
Waste removal  → Reclamation  → Mine closure 

Mining Methods

Short Term Mine Planning & Quality Control 

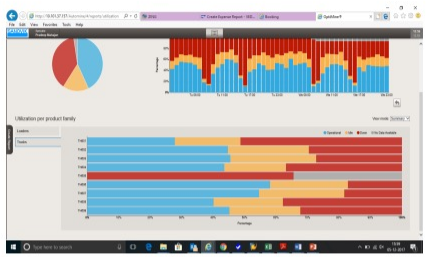
→ Innovative Mining methods & Layout 

Mineral  → Processing → Market


Where to start | A Digital And Connected Mine
Digitised Geological Data
Autonomous equipment
IoT sensors
Wearables
Drones
mobile connected
'Digital Twin'
Remote Operations
DISCOVER & ESTABLISH
EXPLOIT RESOURCES
BENEFICIATE ORE
MOVE PRODUCT
SHIP TO CUSTOMER

Geospatial Technology: Use case

Smart Machines



- Autonomous drilling
- Machine Health Monitoring
- Operator behaviour

In-Motion Weigh Bridge

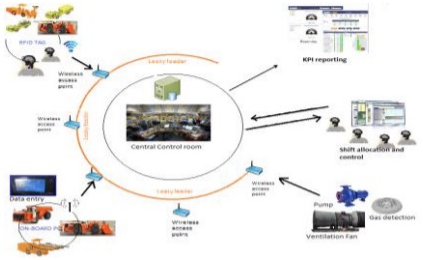
Fill factor improvement to ~ 100%

Haulage capacity increase by 10%

Tele-remote operation

- Autonomous loading during shift change and blast clearance times
- Production drilling during shift changeover

Mine Monitoring



- High bandwidth network infrastructure in u/g
- Tracking of assets
- Gas monitoring system
- Energy monitoring system

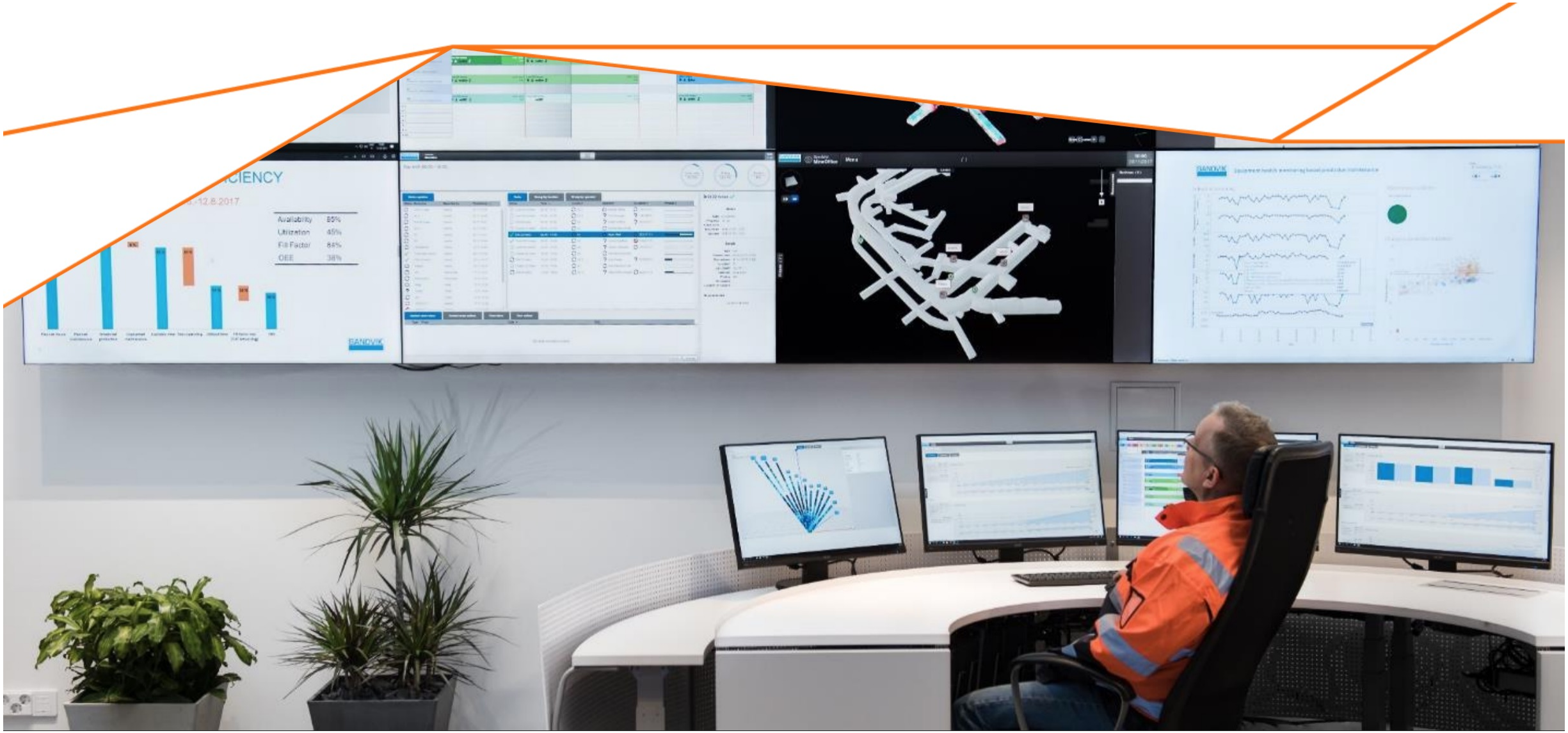
Digital transformation

- Integration of Mine planning with Scheduler
- Process Optimization
- Traffic Management
- Task management system through on-board tabs
- Two –way communication system

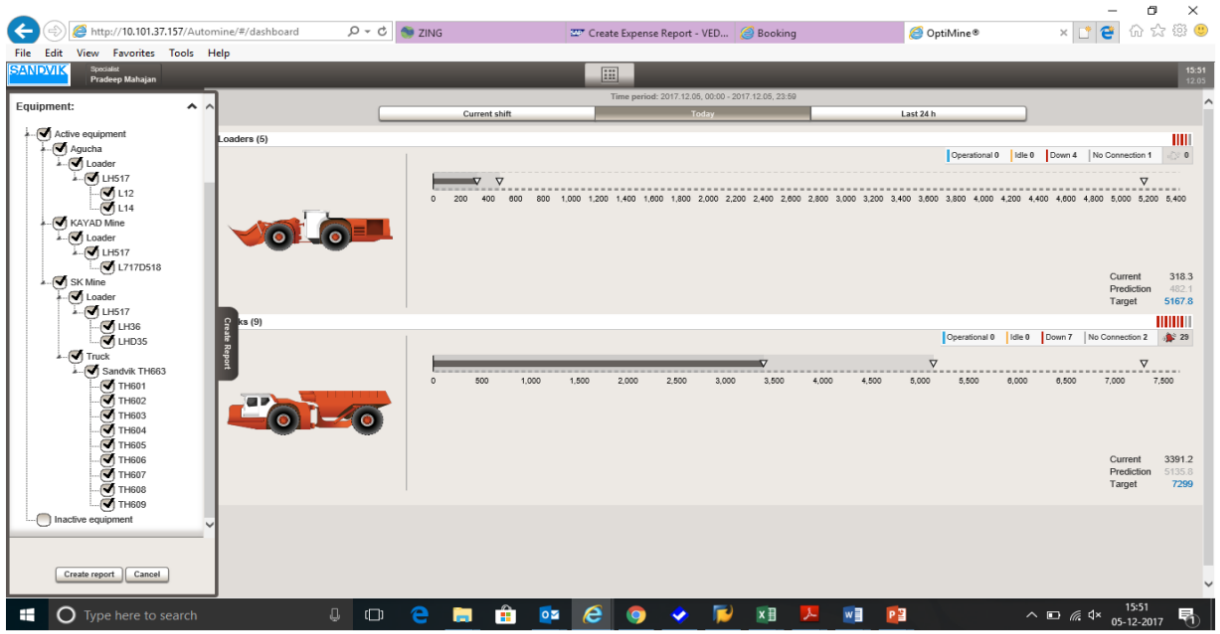
Integrated Operations

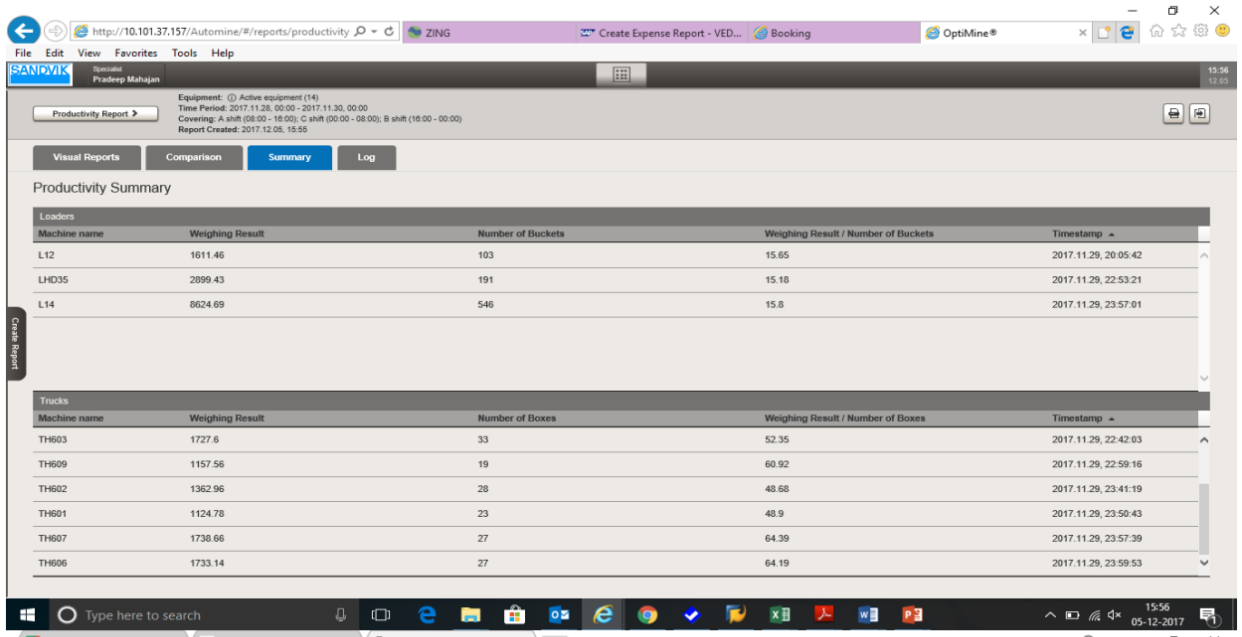
- Centrally managed operations for Mines, Mills, shaft, Paste fill
- Complete process transparency
- Operational efficiencies

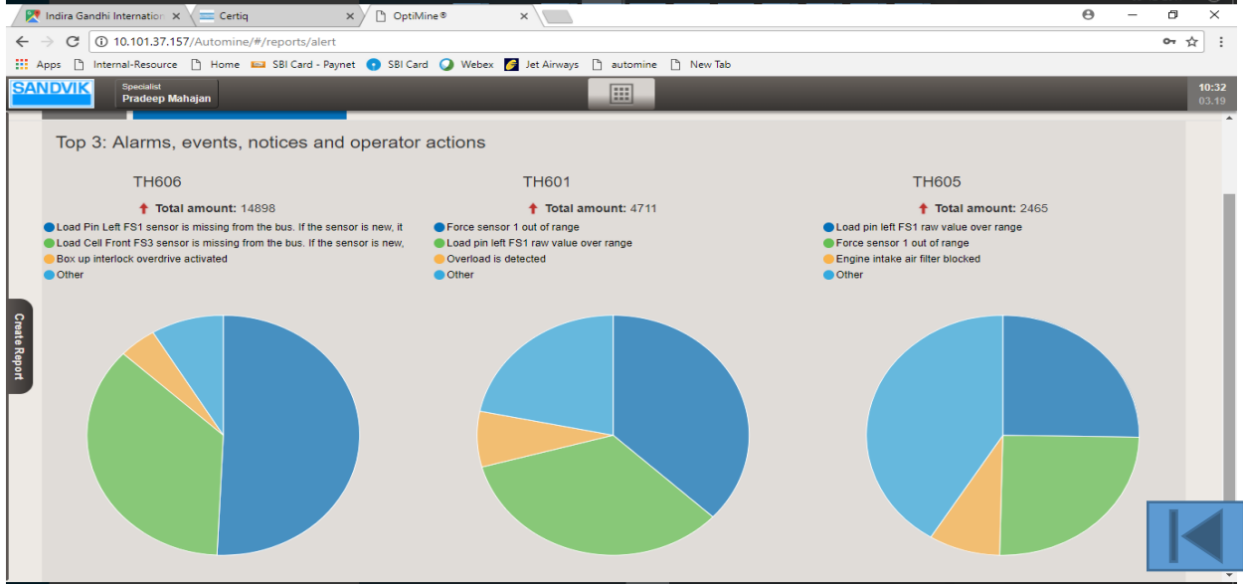
Digitalization use-case



Geospatial Technology: Use case







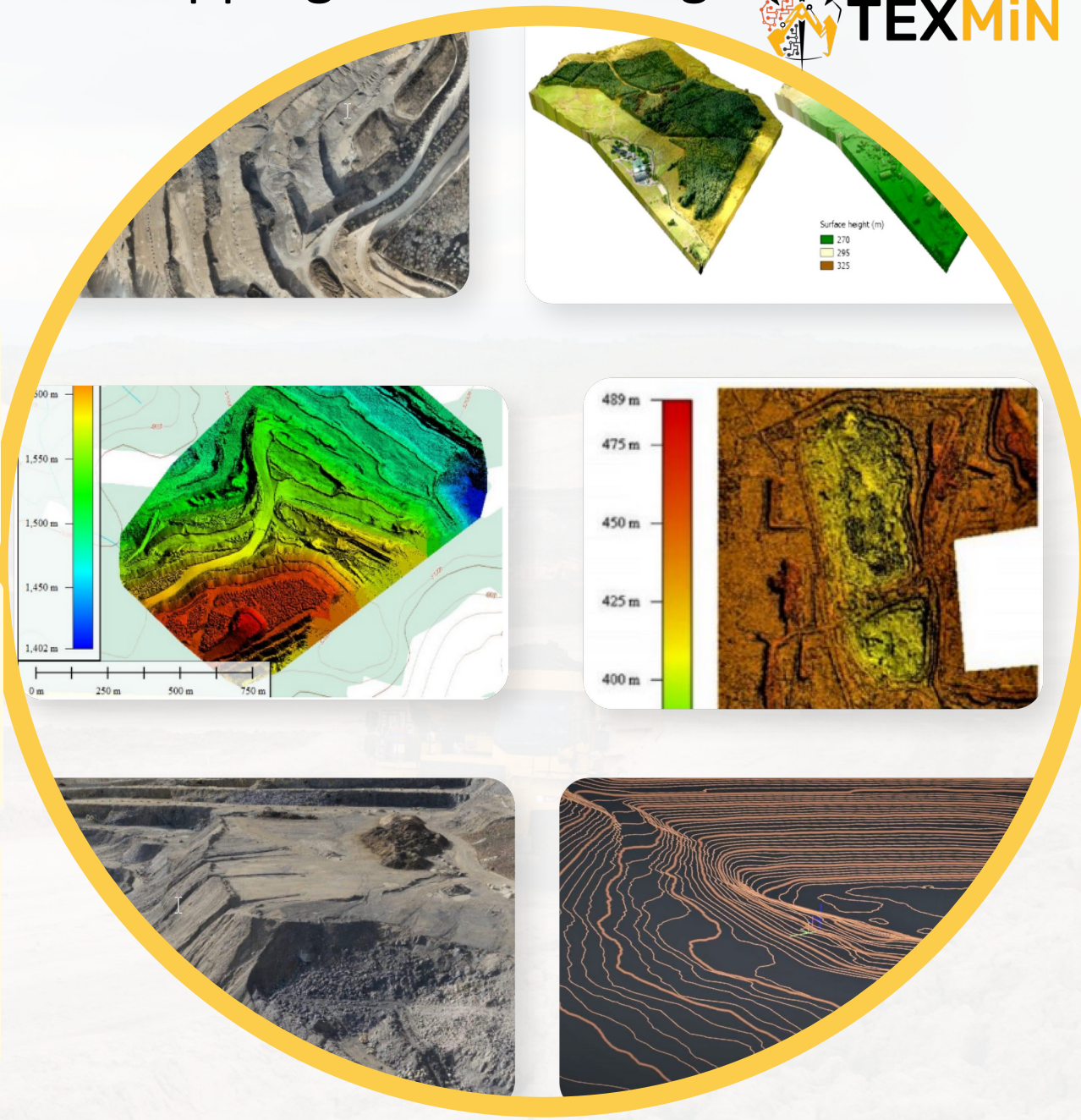
Geospatial Technology: Real-time Mine Mapping & Monitoring

Development of mine data acquisition, management and real time monitoring solution for Orissa Mining Corporation

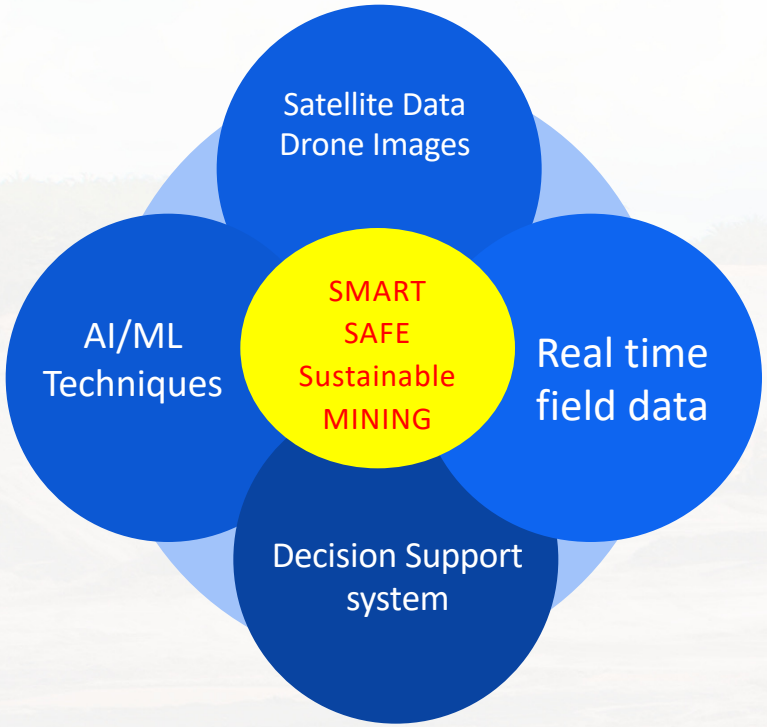
Data Acquisition of given area along with On-field Data Verification

Concept of an ideal solution for complete data management and real time monitoring of OMC mines

Challenges and feasibility of the proposed solution



Monitoring of Mining Process

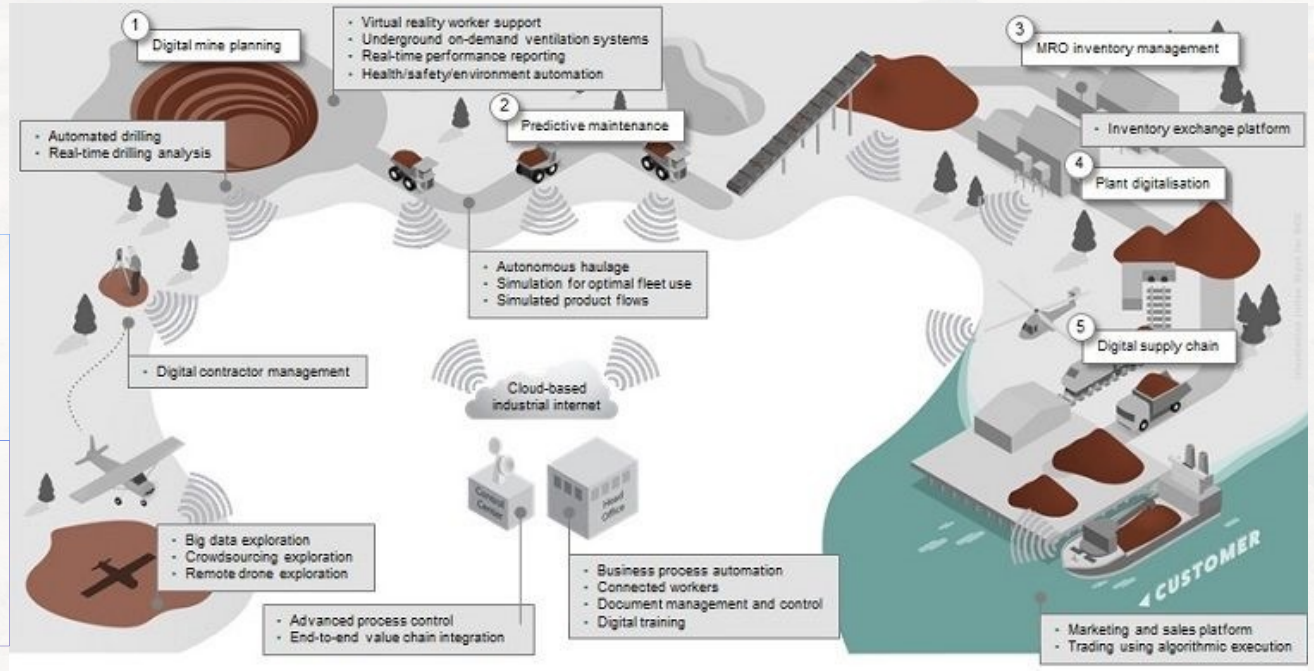


- Resource Tracking & Optimization
- Equipment Tracking
- Monitoring of Mine Reclamation & Restoration

- Drilling & Blasting
- Loading & Hauling
- Compliance Monitoring & Control

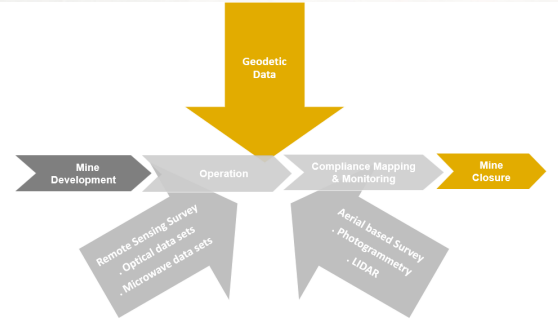
Smart Sensing Technologies

- Monitoring the mine progress remotely in real-time.
- Fusion of Satellite & Drone data with algorithms – DSS
- Machine learning algorithms for accurate extraction of features in mine areas.
- With constant monitoring, understanding the changes that are taking place

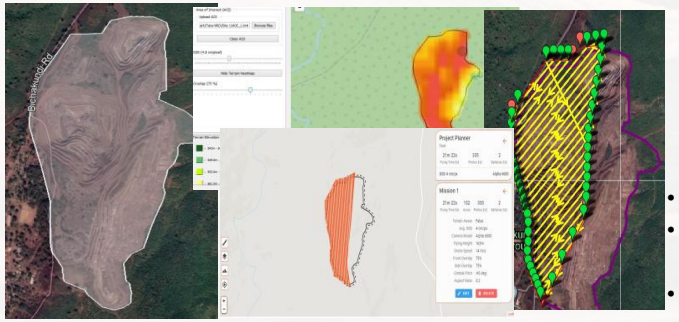


Data Acquisition Process: Drone Data/GNSS Data/TLS Data/Satellite Data

Data Acquisition



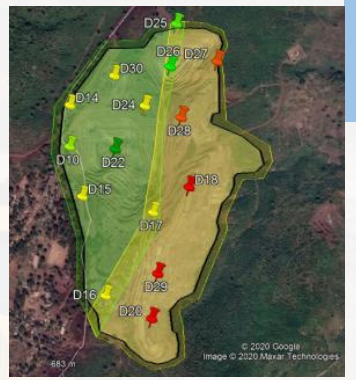
Flight Planning

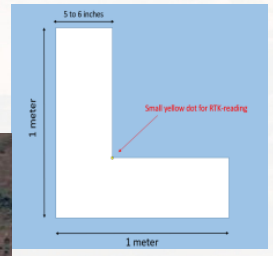


GCP Planning

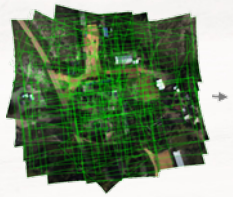
GCPs or the ground control points are used for correction and increasing accuracy of the dataset.

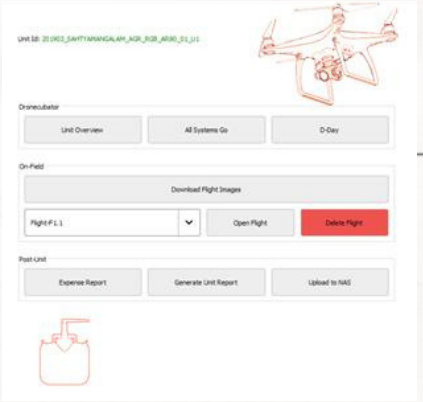
- White L shaped plastic sheets
- Distance between the GCPs should not be more than 250m - 300m in case of mines due to varying terrain
- Minimum 4 GCPs are required for an area
- DGPS team sets the base which is observed for around 8-10 hours
- For every individual point 15-20 min of observation.
- GCP observations(x, y. z) were already made available. 12 GCP points were used in total.

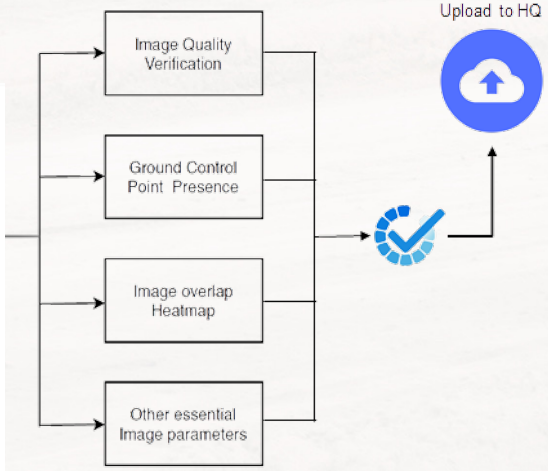




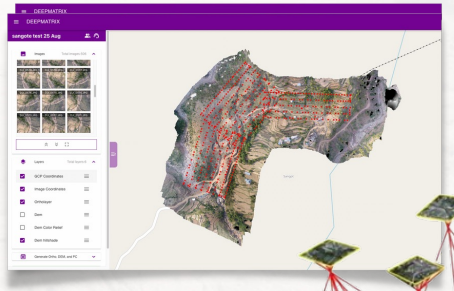
On-field Data Verification

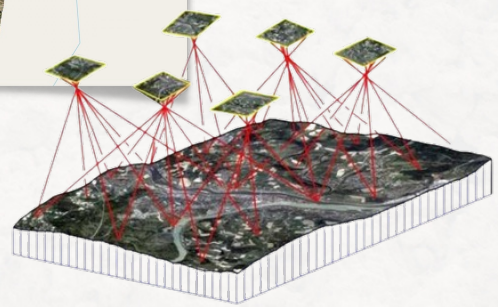


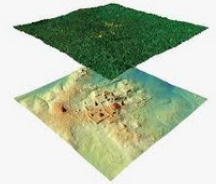


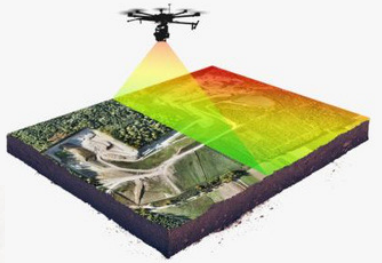


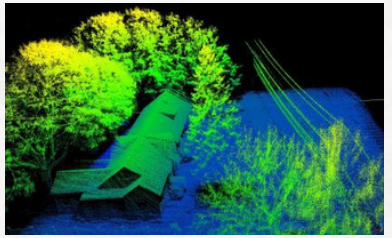
Data Processing





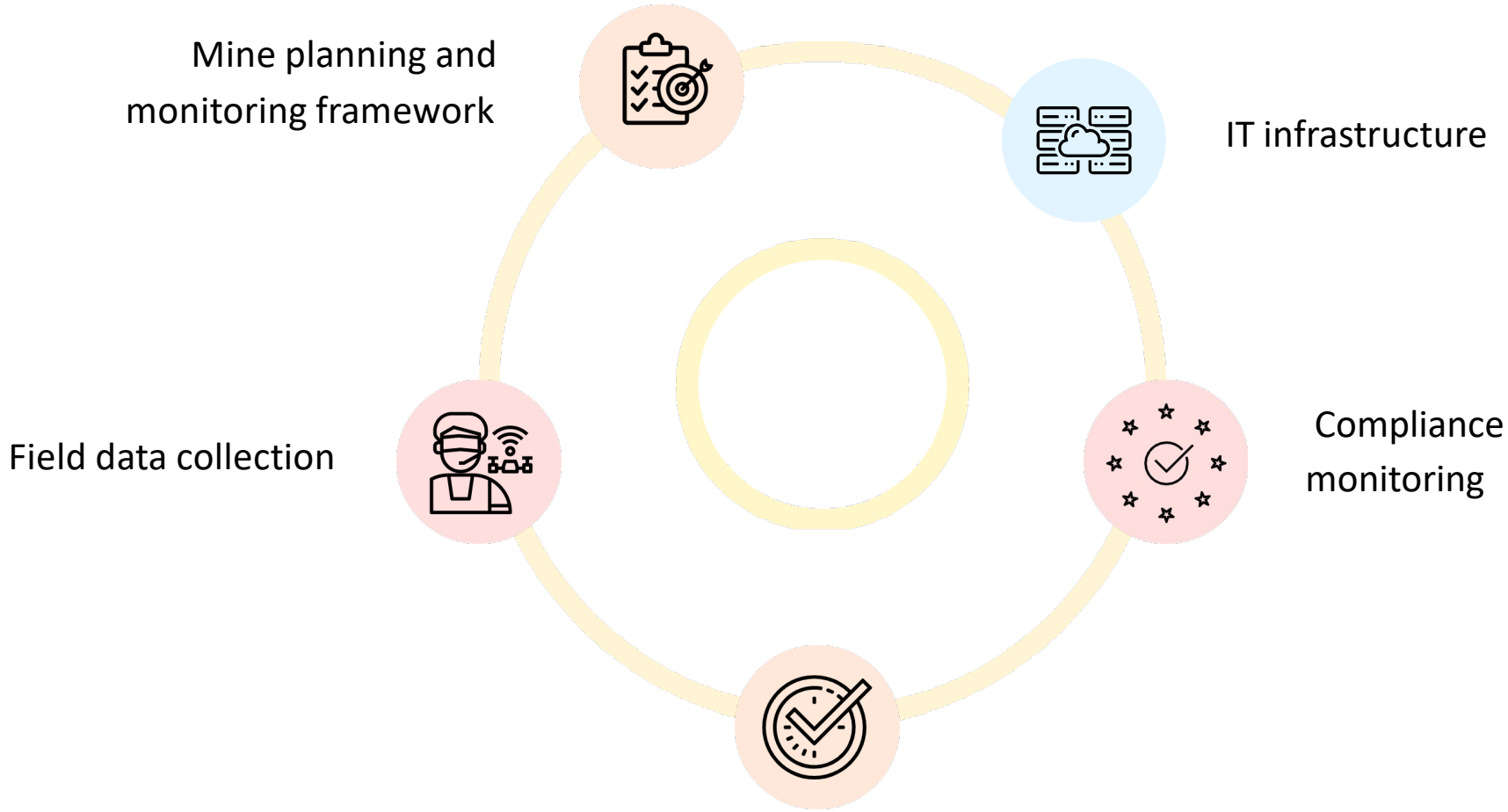






Application of Geospatial Technology: Use Case

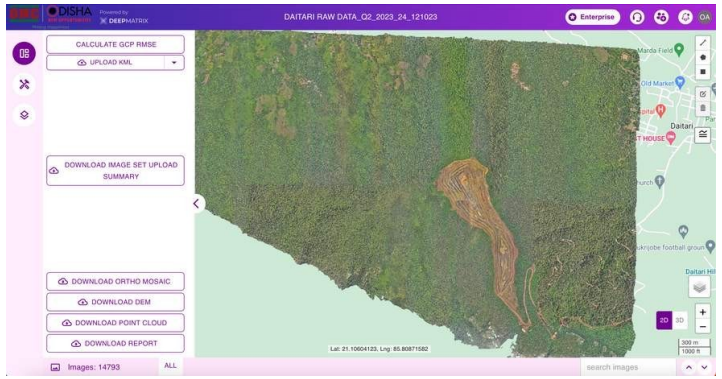
Mine Monitoring



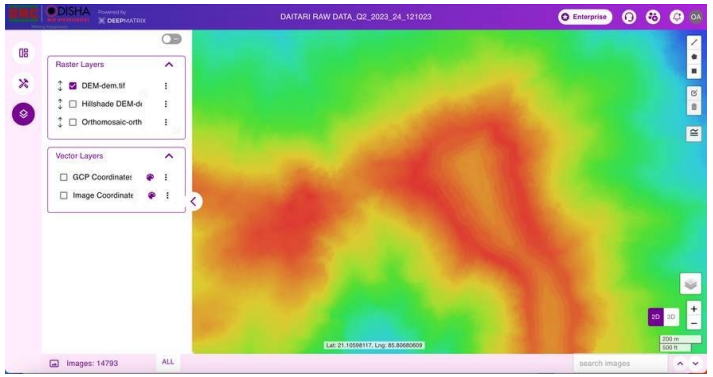
Visualisation of Deliverables on Platform

Deliverables

- Orthomosaic DEM
- Shape files for the area of Interest
- Lease Boundary Pillar co-ordinates
- RMSE Report
- Drone Log Sheet
-



Orthomosaic



DEM, DTM & DSM

DEM Hill Shade

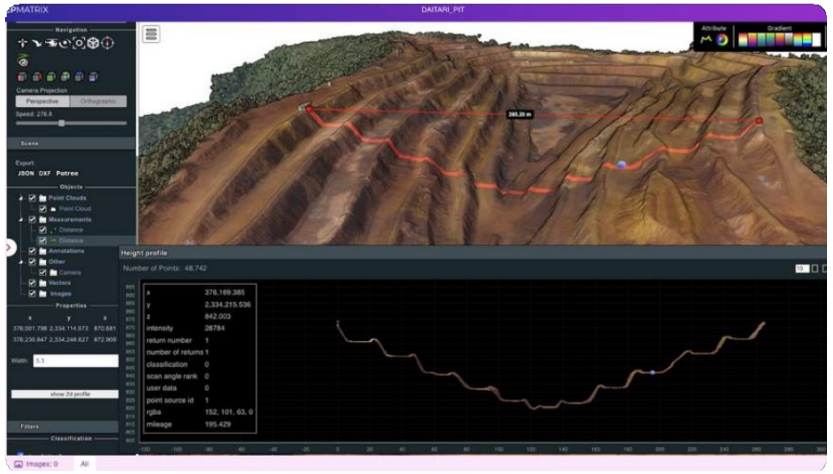
GCP Visualisation and Accuracy

Analytics Visualization

Volume Calculation

Slope Calculation

Area Calculation



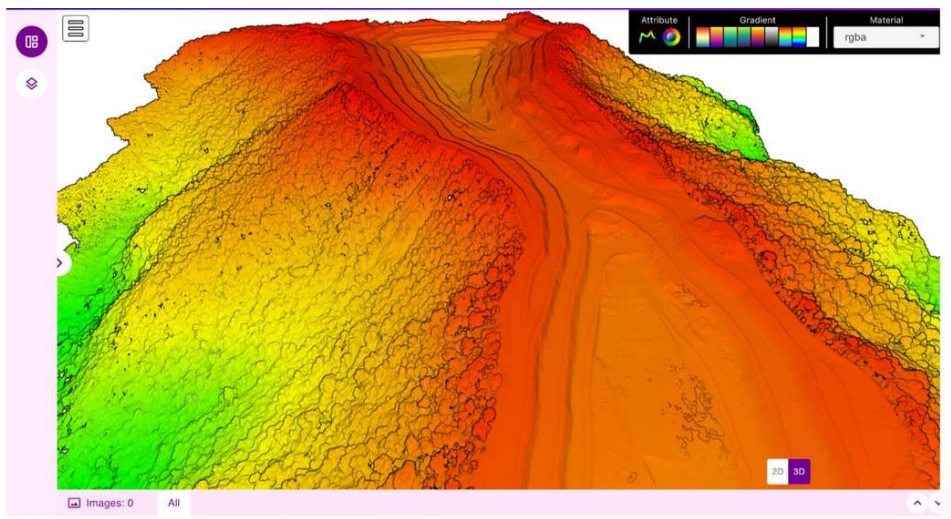
Bench height measurement

Cross section profile along with measurements

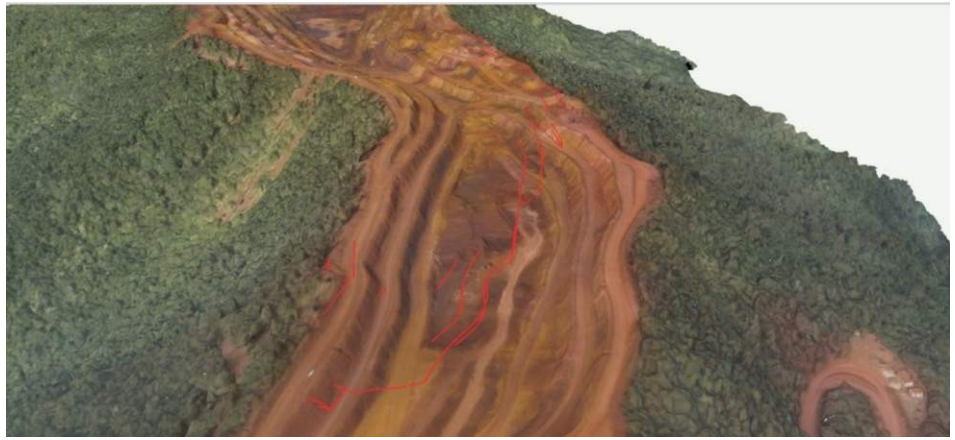
Measurements along the haul road

Analytics and Visualisation

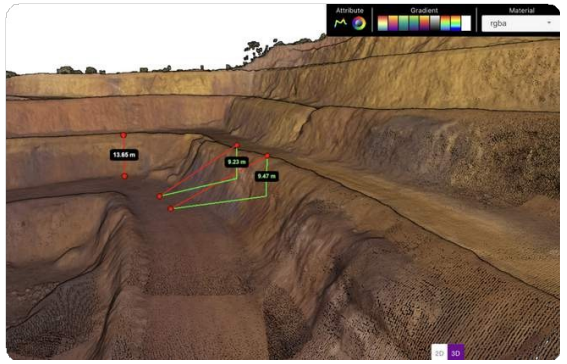
3D visualization of the point cloud

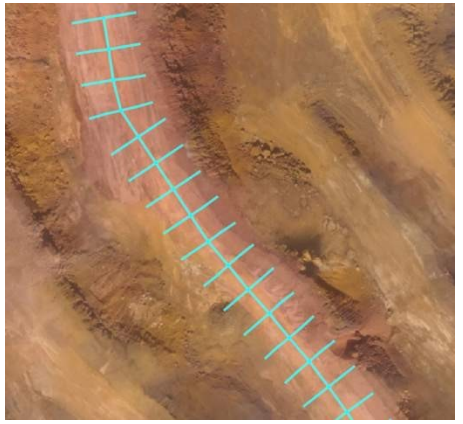


Colour themes based on height



3D model visualization of large scale data with plan (KML) overlay





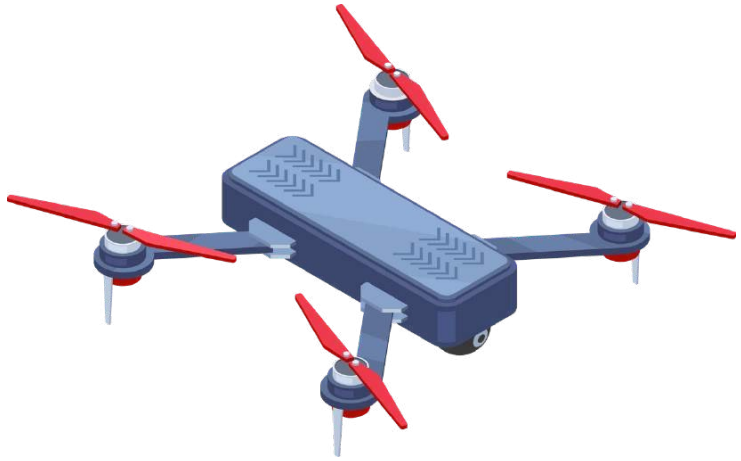
Haul road slope measurement

Real time Monitoring : Fleet management

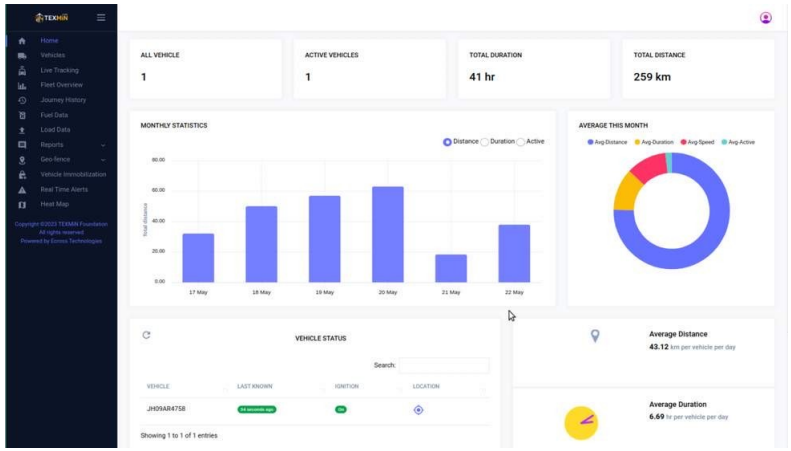
- **Live Location**
- **Remote Engine Cut-off**
- **Pilferage Tracking**
- **Fuel Tracking**
- **Video Telematics**

Real time Monitoring : Visual data

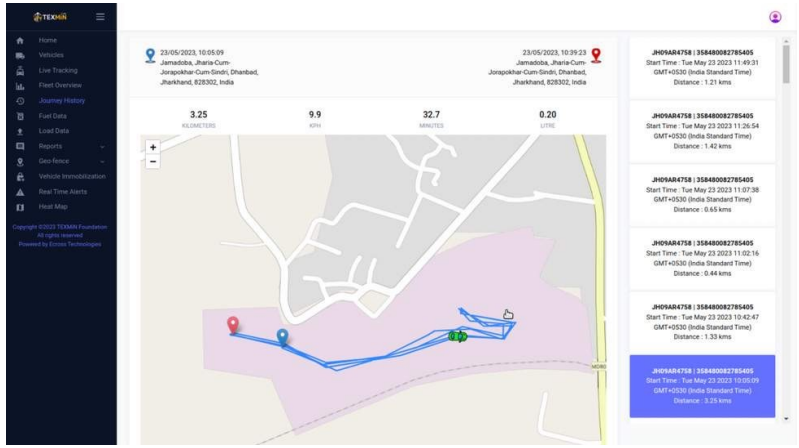
- **Live feed from drones**
- **Live feed from CCTV**
- **Real time analytics for enhances safety**



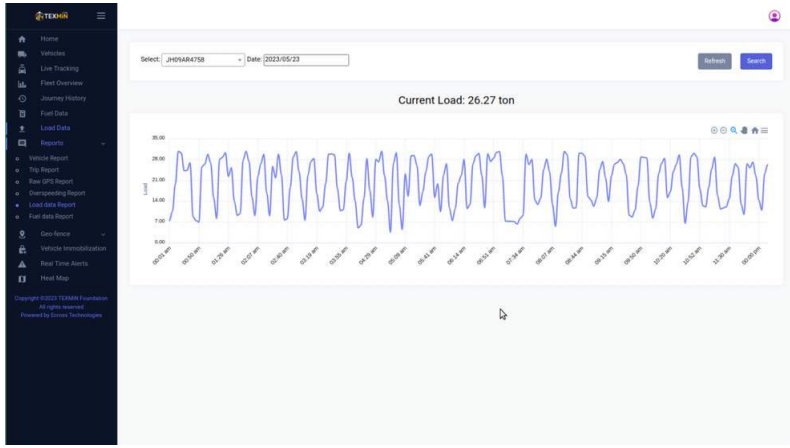
Real time Monitoring



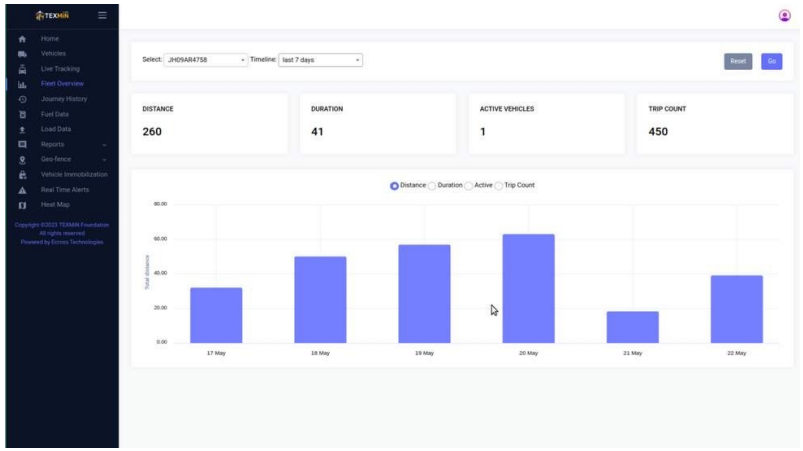
HOMEPAGE - ANALYTICS



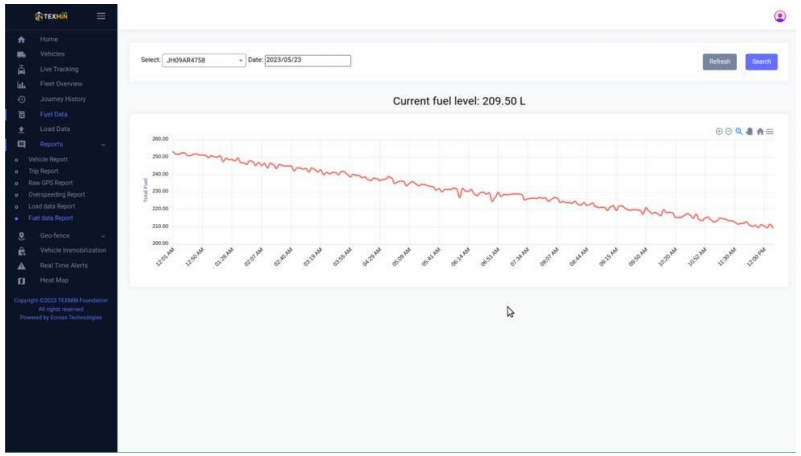
ROUTE PLAYBACK & JOURNEY HISTORY



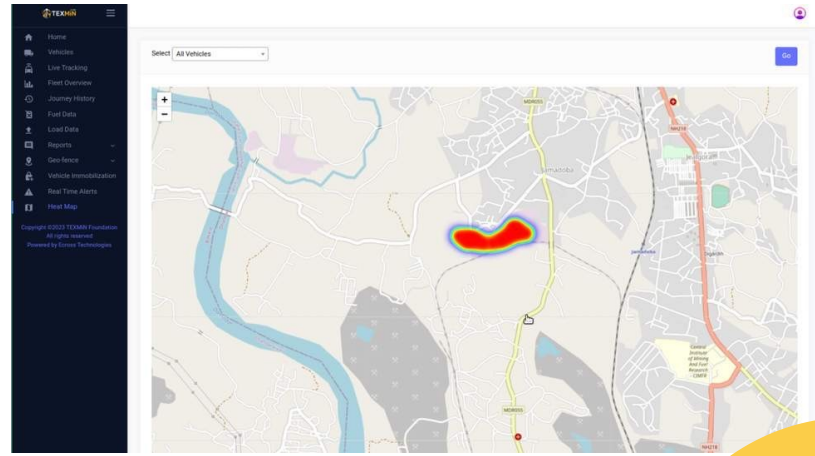
PILFERAGE MONITORING - GRAPH



DISTANCE CHART



FUEL MONITORING - GRAPH



HEAT MAP

IIT (ISM)

TEXMiN

Implementing Mining 5.0: Success Stories of Indian Mining Innovation & Startup Ecosystem

TEXMiN – IIT (ISM) Dhanbad

• SMART • SAFE • SUSTAINABLE • • SCIENTIFIC

• SOCIAL• (5S) MINING

Prof Dheeraj Kumar

Project Director TEXMiN & Dy. Director, IIT(ISM) Dhanbad

सत्यमेव जयते

Department of Science & Technology
Govt. of India

National Mission on Interdisciplinary Cyber Physical Systems
NM-ICPS

Legacy that Inspires the Future

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भारतीय खनि विद्यापीठ
धनबाद

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05.04.2024

About TEXMiN, IIT(ISM) Dhanbad

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IIT (ISM) TEXMiN

TIH at IIT (ISM): Technology Vertical 'Technologies for Mining' (Exploration & Mining – Technology Innovation in Exploration & Mining Foundation – TEXMiN – A Section 8 Company

IIT (ISM) Dhanbad:

- Rich Mining ~100 years in Mining & Upstream Exploration Heritage
- Natural Resources Backdrop: East India Mining belt provides unparallel Infrastructure
- Best of the class talent pool and research infrastructure

Office premises: Institute Innovation Hub (i2h), IIT (ISM) Dhanbad

45+ Technologies and Products developed so far…

Problem Statements source

Various Ministries

- Ministry of Mines
- Ministry of Coal
- Ministry of Telcom
- Ministry of Electronics and Information Technology

Our Clients

and searching..

and many more...

IIT (ISM) TEXMiN

SME (Subject matter experts)

- Academic Institutes (15)
- Industry experts (100+) - Inhouse experts

Our Collaborators

..and many more

International collaboration

Curtin University

TALPA SOLUTIONS

Carlson

IIT (ISM) TEXMiN

Solution Dev & Commercialization

Our Startups

bidaal

nyunai

Climate-B Ventures Pvt. Ltd.
Building Resilience. Empowering Enterprises.

DEEPMATRIX

NIRAL NETWORKS

FUTUROTEC SOLUTIONS

ExoCortex

FxUAV

ECROSS TECHNOLOGIES

PINNACLE

GRAPHENERA CARBON PRIVATE LIMITED

VYOMCHARA INCUBIG

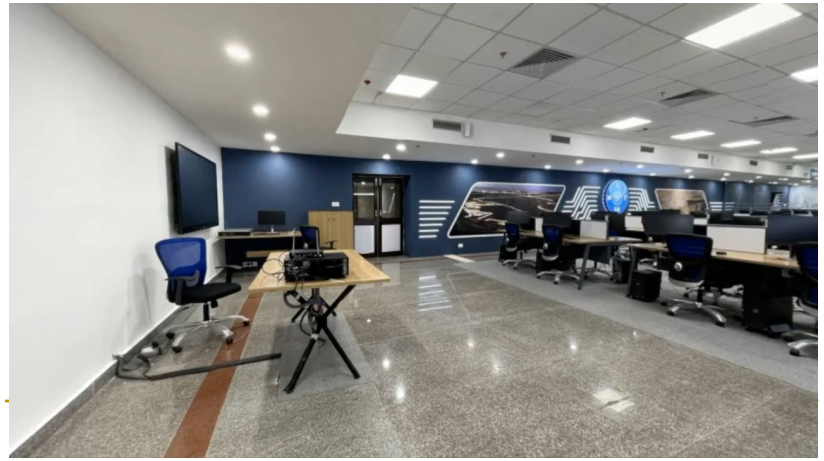
EasyM2M

QuroLabs

Other Indian Startups

Few Established CoE's - In Kind Support from Industry Partners/Collaborators

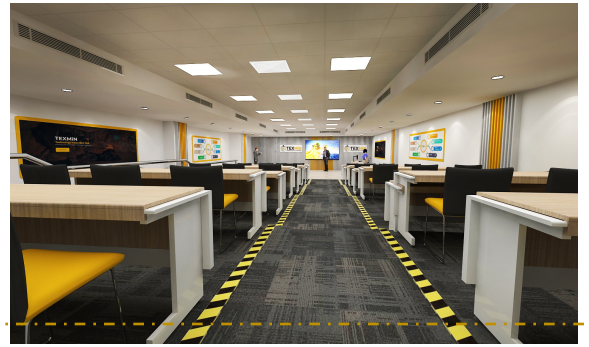
Sandvik Mine Automation Learning Centre



Mining Technology Excellence Centre – TEXMiN & Dassault

Coal India Innovation & Incubation Centre

TEXMiN - Esri Geospatial Excellence Centre



TATA Innovation Centre for Mining & Mineral Research

AEL 3S Mining Excellence Centre

TEXMiN – Carlson Geodesy Centre

HEXAGON

TEXMiN – HxGN Centre of Excellence ("CoE") - WIP

Digital Mining and monitoring in mines known as Centre for Digital Transformation & Excellence in Mining & Monitoring ("CDTEM2") – MoU signed dated 12.02.2024 at Embassy of Sweden.

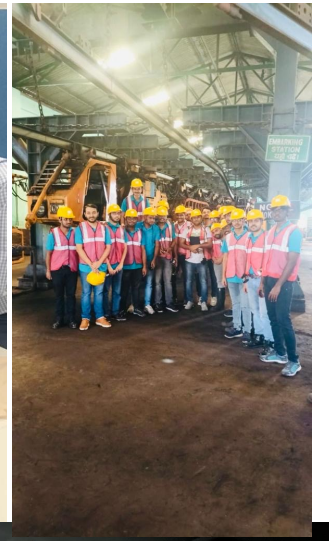
Quite a few in Pipeline…

Capacity Building

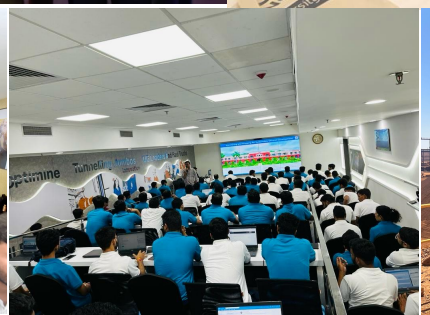


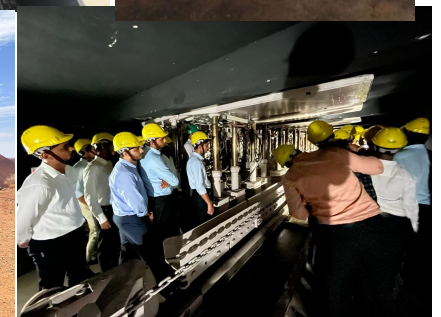








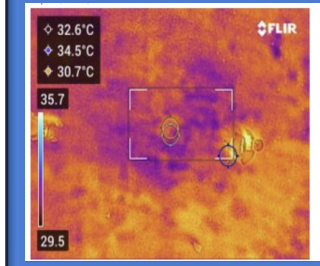
Geospatial Technology: Infrastructure for Mining

Video Telemetry via Drones

Immersive Real life visualization

Tele-operations (PoC)

Jharia Mine fire monitoring



Remote and Hazardous location inspections

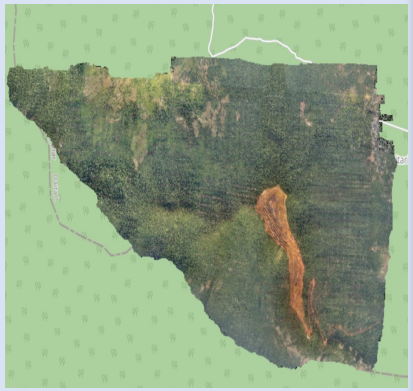
Remote IOT connect


TEX
EXPERIENCE CENTRE
ENTRY
MINING OF THE FUTURE
3s Mining using Private 5G networks


IIT (ISM)
TEXMiN


3 कार्गो लिफ्ट CARGO LIFT
IN PARTNERSHIP WITH
Department of Science & Technology, Government of India
National Mission on Interdisciplinary Cyber-Physical Systems (NM-ICPS)
IIITB COMET FOUNDATION
MANTISWAVE NETWORKS
IHFC
Technology Innovation Hub of IIT Delhi

Real time Mine monitoring - Visualize

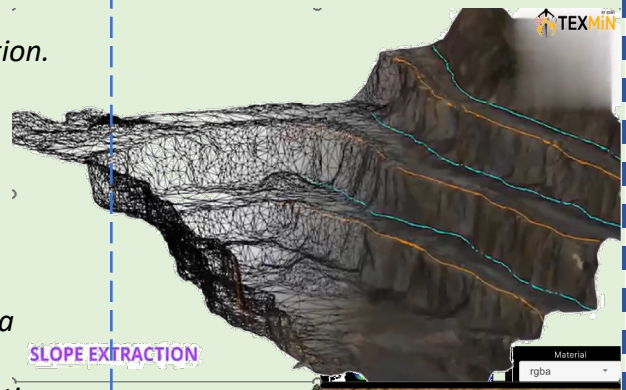


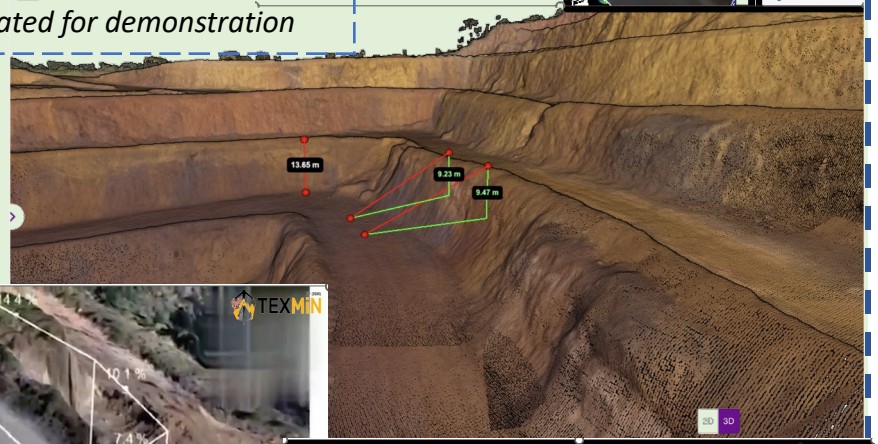
Status :
Holographic Visualization platform ready.
Data processing platform ready for integration.

Visualization device –
Ready to be placed at HQ / Mine office

Data Processing – At Cloud

Data Acquistion through 5G drones/ Camera
- *Drone Prototype stage*
- *Camera can be integrated for demonstration*





Real time mine measurement : Measure

IIT (ISM) TEXMiN

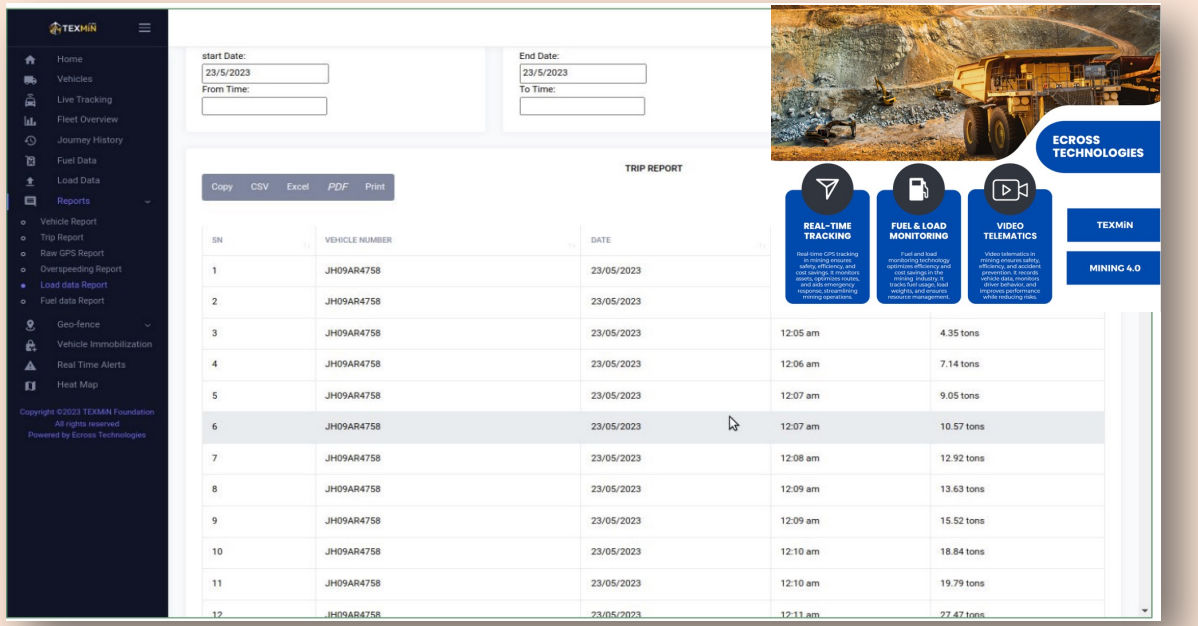
IOT Sensors integration via 5G Remote Terminal Unit (RTU)

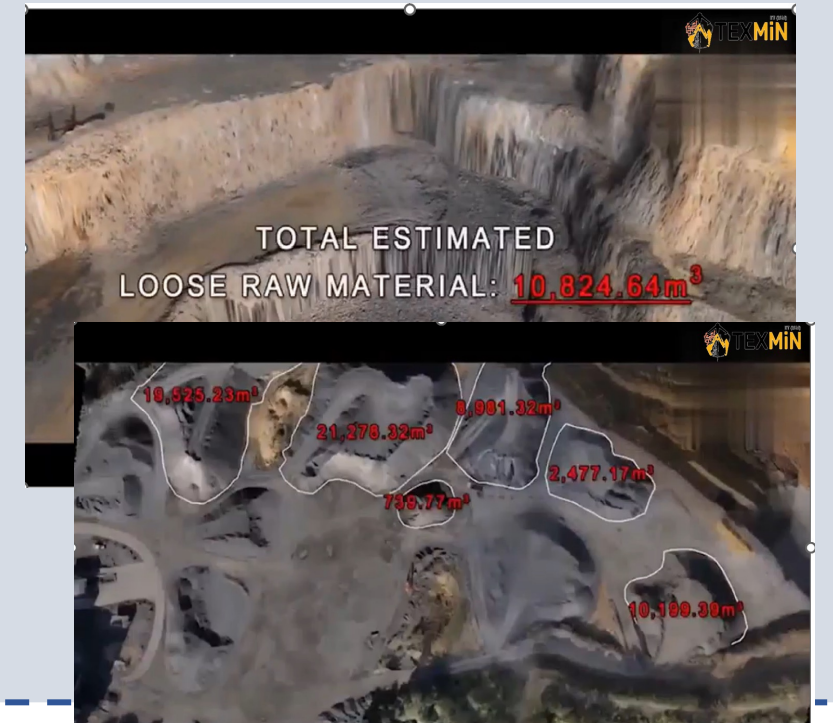
Connect and control any sensor/device over 5G!

Already integrated sensors

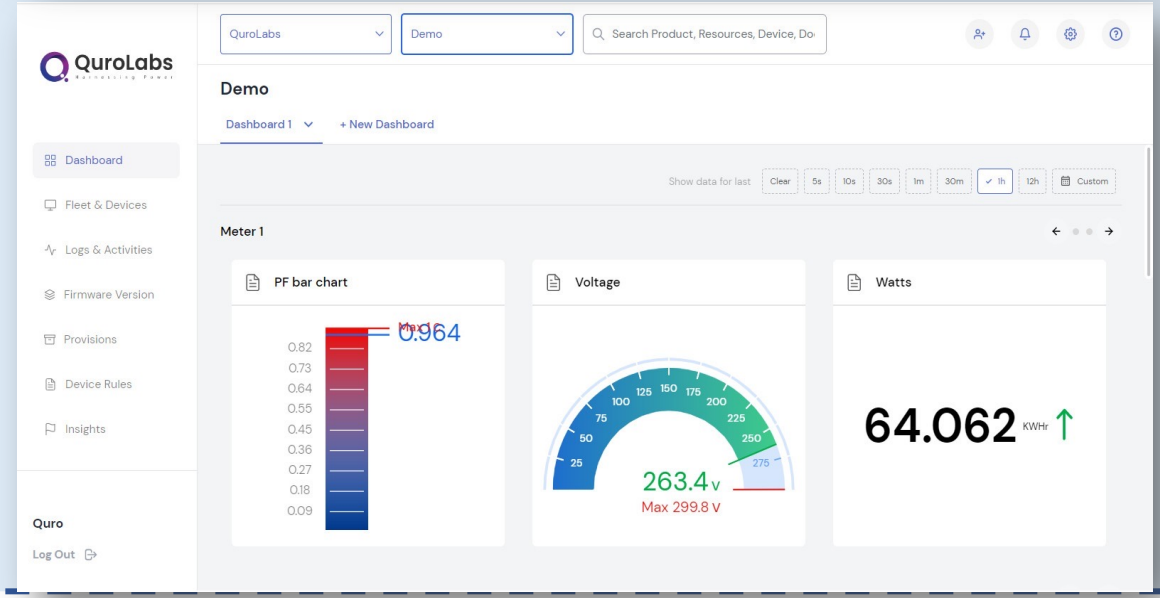
- Flowmeters
- Pressure transducers
- Temperature sensors
- Gyros
- Cameras
- Energy meters

Asset tracking platform is ready for integration with Private 5G





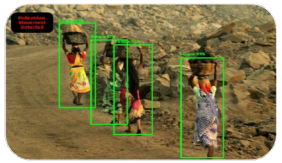
Energy management cum monitoring system – Ready



Real time mine : Analyze

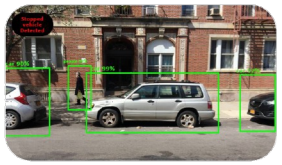
AI enabled mining activities monitoring

Traffic Analysis
Count cars, trucks, bikes, bicycles, and other objects



Pedestrian Detection
Workers counts, tracking and efficiency calculation

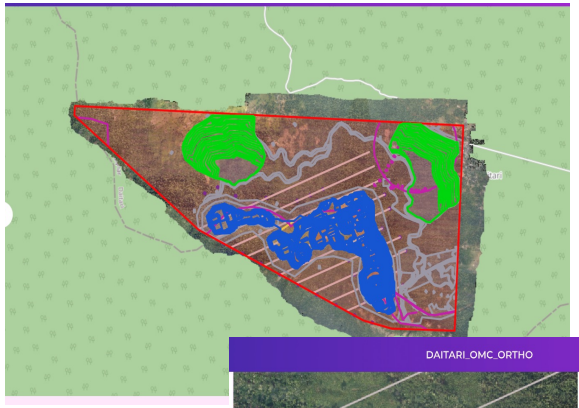
Unsafe activity Detection
Unsafe activity according to businesses

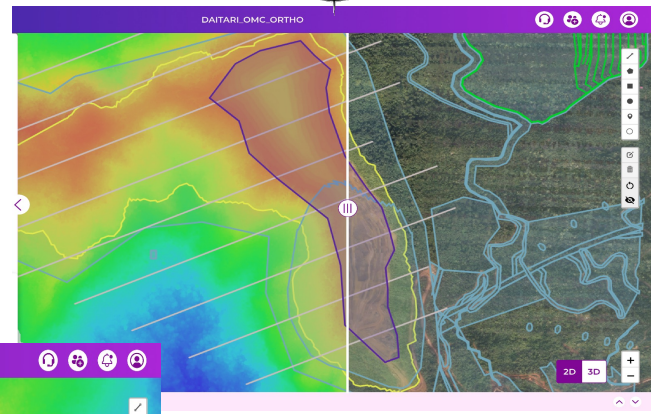


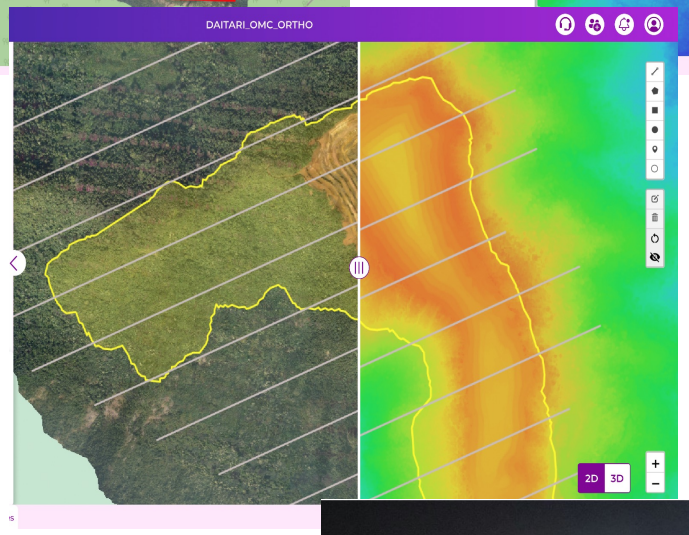
Stray Parking
Stray time calculation and alerts to the facility manager

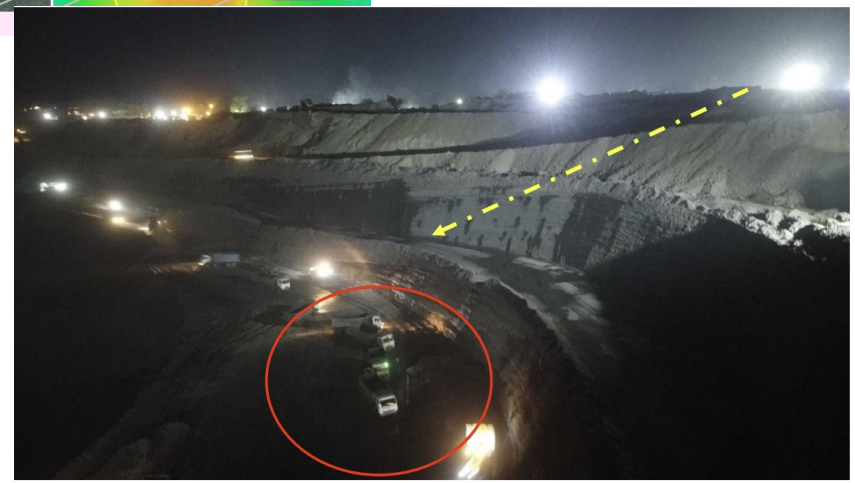
Near Miss Violation
Spot the potential accidents at hotspots to take measure action.

Accident Detection
Real time alert for the facility manager to take action







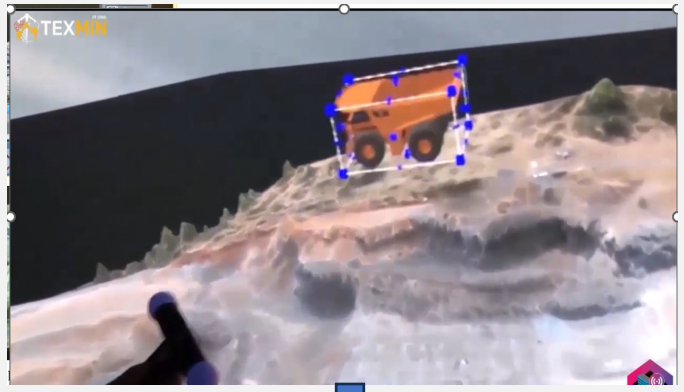


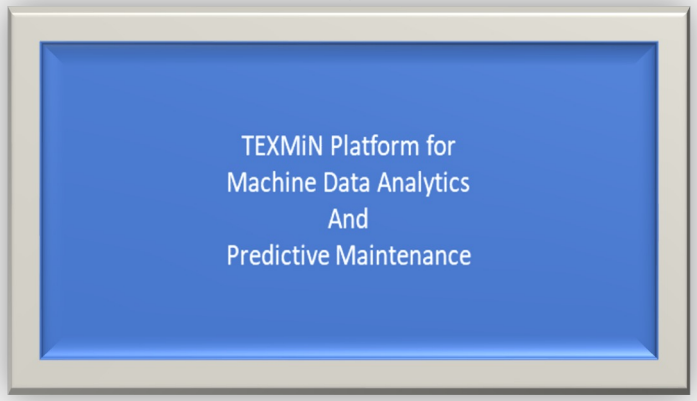
Real time mine - Communicate

- All voice to voice communication
- Sensor communication
- Operations point to Pit communication
- Machine to machine communication

Control devices e.g.

- Switch on/off devices
- Alarms
- Regulate light intensities
- Any analog control
- Displays





Status : AI models for Predictive maintenance Done
Support required for Data Collection from Equipment OEMs

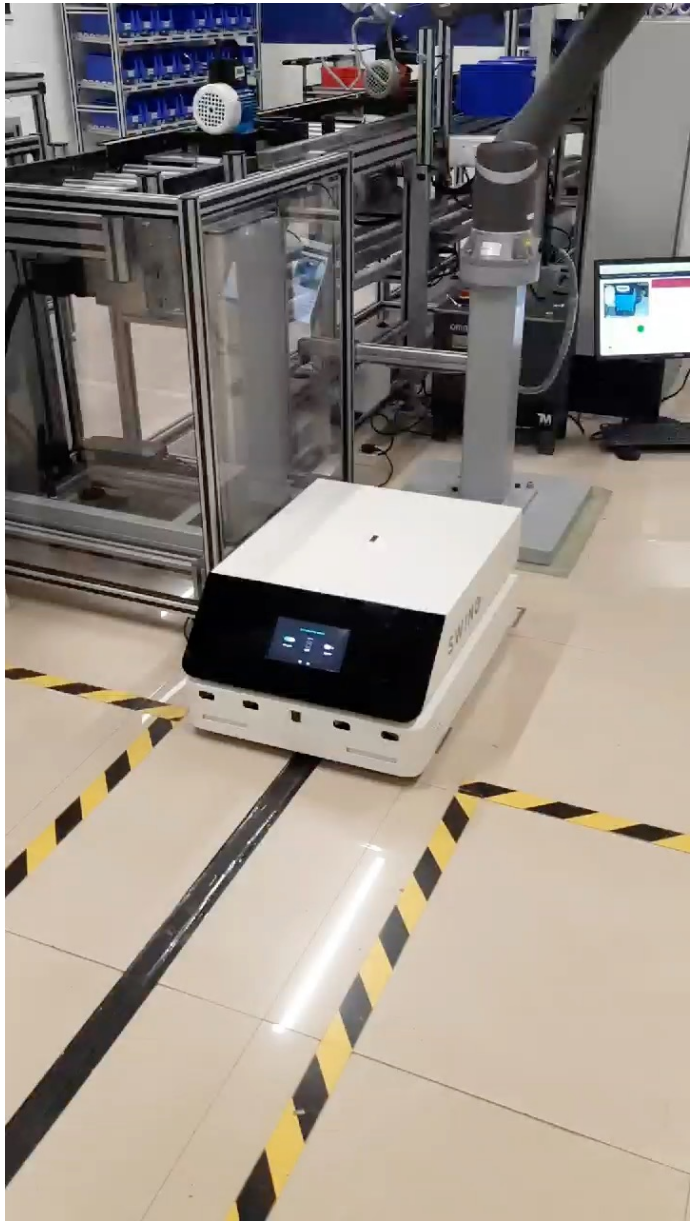
Status :
IOT integration to Holographic System done
Video telematics features – POC stage done

Underground Mine Communication

GPT for Indian Mining Industry including Holographic Technology

Real time mine – Operate (To do)

Automated Guided Vehicle



Automated Coal Sampling Station

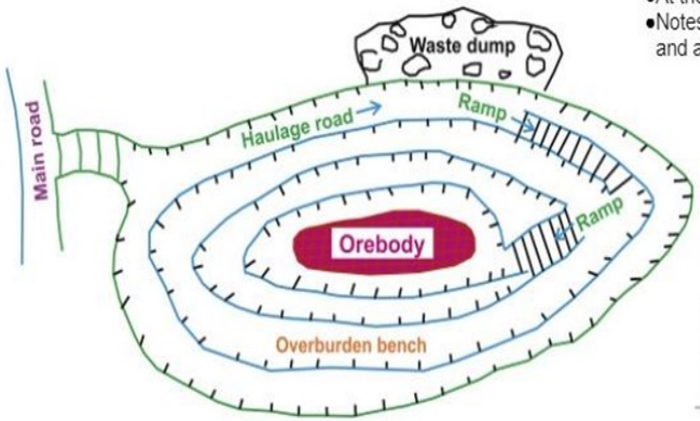
Mines Entrance

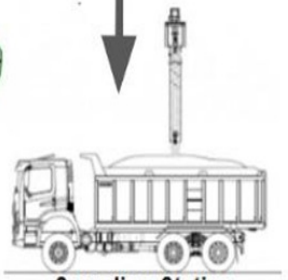
Security Face Scanning and ML based Image Processing

- Truck No., Model No, Driver details and the company name from where the truck is coming
- picture view of blank dumper
- If error found - Weight range +- 100kg (depending upon the model) will be noted
- If again error found - Alarm beep

Weight sensor

- At the bottom weight machine
- Notes the weight of the truck before and after the loading of coal





Sampling Station

Mines Exit Point

Mechanised Tubular Auger Sample Collector

- Designed for collecting true representation of samples from a depth of about 2 m in transport containers, such as trucks, open-top shipping containers
- Consists of Spiral tapered Annular Auger tube for collecting sample and spiral mechanism to take the coal sample into it.

Final report as a receipt (Exit point)

- Includes the driver details, company, weight of the coal loaded on the vehicle, time spent in mines

Few other Technologies

Project SAGES

Objective

- ❑Design & Development of Four SAGES
  - ▪Capacity 500 T and
  - ▪Range 2.5 - 4.5 m
  - ▪Suitable for use with continuous miners (CMs).
- ❑Field trial of 500 t capacity SAGES in depillaring operation with the continuous miner at Churcha RO underground mines of SECL (Baikunthpur Area).
- ❑Techno-economic study of the deployment of SAGES (500 T) with the Continuous Miner.

VR Technologies

Mino VR – Mine to Meta

Underground mine environment models
Machine models, operation and animations with sound effect

Optical Bore tele-viewer

Optical Borehole Tele viewer

Detailed and oriented structural information
Fracture detection and evaluation
Breakout analysis

Electronic Borehole Compass

TRL 04 → TRL 08

Area of Application

Exploratory Drilling : Recording, analyzing, and keeping a detailed record of drilling deviation parameters by plotting their graphs

Long hole Drilling : Identification of blast hole deviation in ring drilling during stoping

Fracture Orientation : Measurement in hydraulic fracturing method for estimation of the in situ stress orientation

Successful Pilot – Churcha Colliery and Moonidih Colliery

International Price INR 30 lakhs | Our cost INR 50k

How to get into a cooperation

01	ACHIEVE A COMMON UNDERSTANDING OF A COLLABORATION
02	DEFINE KEY RESULTS AND OBJECTIVES
03	EVALUATE THE OUTCOME
04	ROLL-OUT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Innovation
UG Loaders


aders And Haul Trucks


M Prasad


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Thank You !


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