Increase your metal recovery with real-time, AI-powered interconnected apps

‘Scientific AI in Real-Time’

Tech Talk, Kalgoorlie, WA

22nd February 2024

Carl Smith - National Account Director APAC

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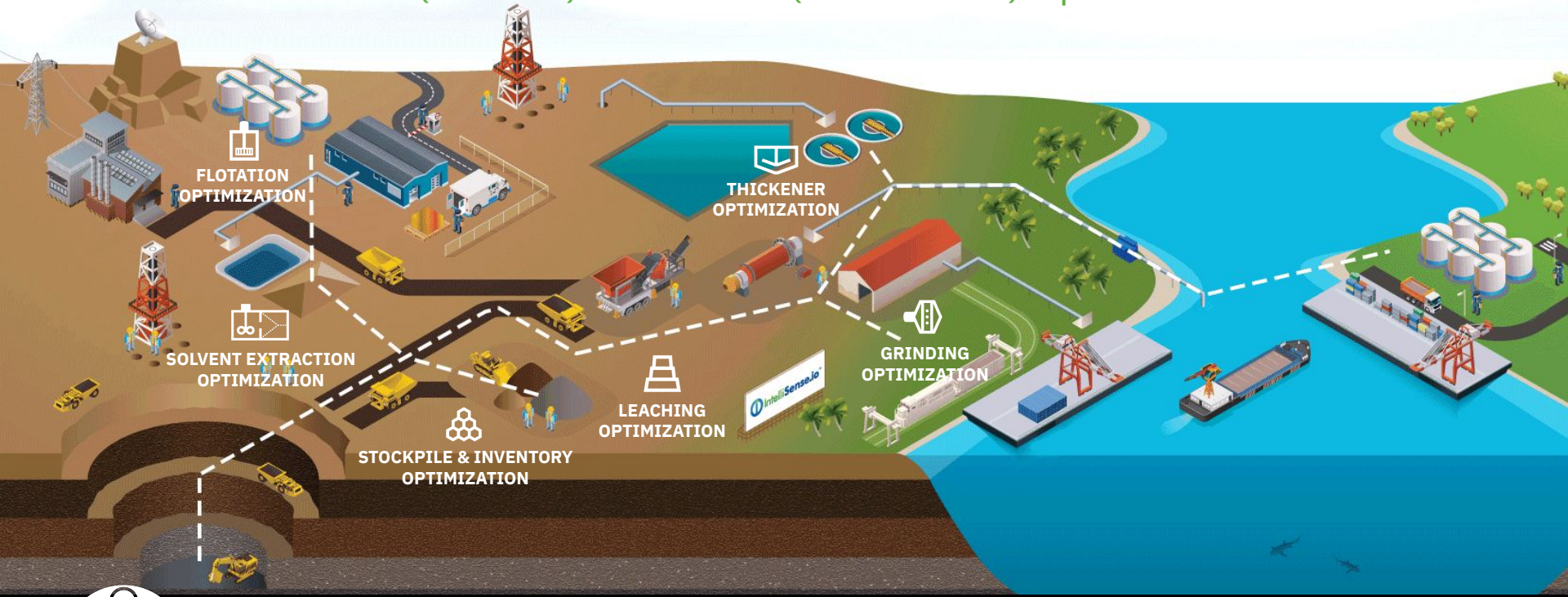
Connect and Optimize the Mine to Market Value Chain

Local (Process) and Global (Value Chain) Optimization

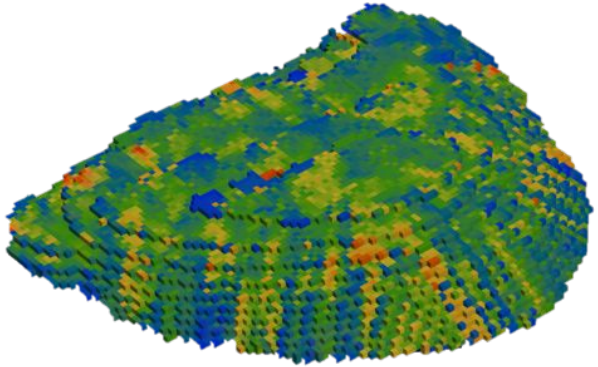


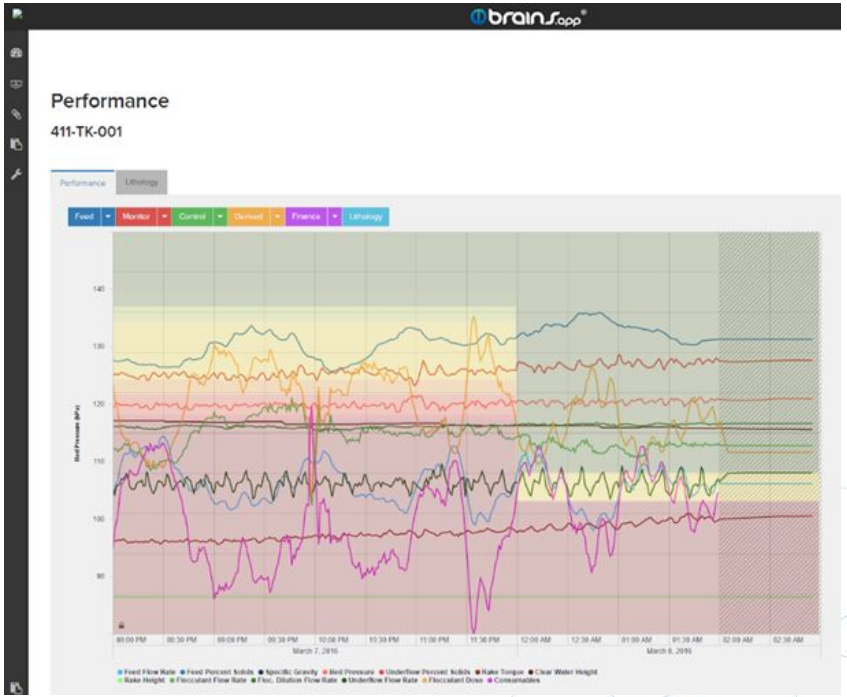
Employees: 100+ **Industry:** Dedicated to the Metals Value Chain **# of live sites:** 27

HQ: Cambridge, UK **Regional HQ's:** Australia (Perth), Chile (Santiago), Kazakhstan (Almaty)

Breaking the Silos

High Granularity: Cross Discipline Decision Making





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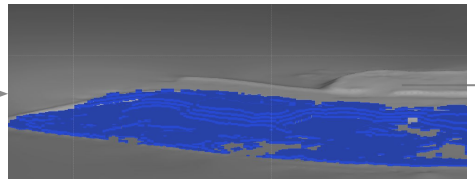
Connected Solution

Stockpile Management: From WAM to a 3D Block Model

'Weighted Average Model -WAM' treats all Material as equal

TODAYS APPROACH



? **UNINFORMED DECISION MAKING**

Open Pit

Underground

Load & Haul

Mine Stockpile

Doze

Load & Haul

Primary Crusher

Coarse Ore Stockpile

Plant

FMS Data

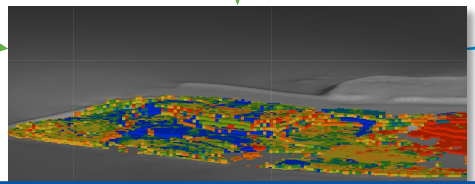
Geophysical Data

Material Drift

Informed Reclaim & Blending Decisions

Know Exactly What Material is Coming

NEW APPROACH



MATERIAL HANDLING KNOWLEDGE

Material tracked with granular 3D Block Model and Material Handling Model

! **INFORMED DECISION MAKING**

Allowing Operators to:

- Improve blending decisions and reduce feed variability
- Improve compliance to plan
- Improve reconciliation accuracy
- Stabilise plant & optimise performance

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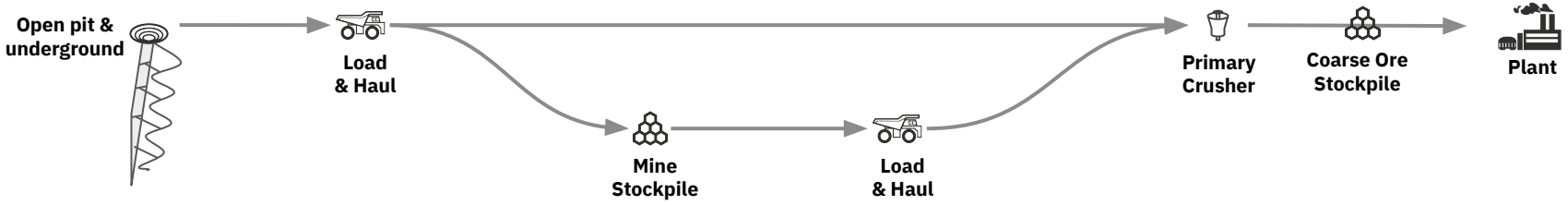
Data Synthesis

Stockpile & Inventory Optimization Application



Material Properties

Geological block models

leapfrog · MICROMINE · SEEQUENT · MAPTEK Vulcan

Ore control models

OREPro 3D · minesense · Deswik · MAPTEK

Material Accounting & Stockpile Sampling

SNOWDEN Optiro · DATAMINE

Lab work

ThermoFisher SCIENTIFIC · Autoscribe INFORMATICS

Online analyzers

IMA

Material Movement

MillROC MINERALS PROCESS OPTIMISATION

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FMS & GPS (trucks, shovels, dozers)

CAT MineStar · Wenco Getting More Out of You · Pitram

Manual data entry

MODULAR MINING

Survey scans

Bentley · KAYRROS · propeller

Weightometers

AVEVA

Stacker/reclaimer positions

Rockwell Automation · OSIsoft. · Honeywell

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Stockpile Management Challenges

‘Weighted Average - WAM’ Models

1. Limited knowledge - leading to **high ore variability feed to plant** affecting throughput, recovery and grade

2. **Low accuracy** in mine planning and blending strategy

3. **Lack of connection between spatial and time series data** limiting proactive upstream and downstream decision making

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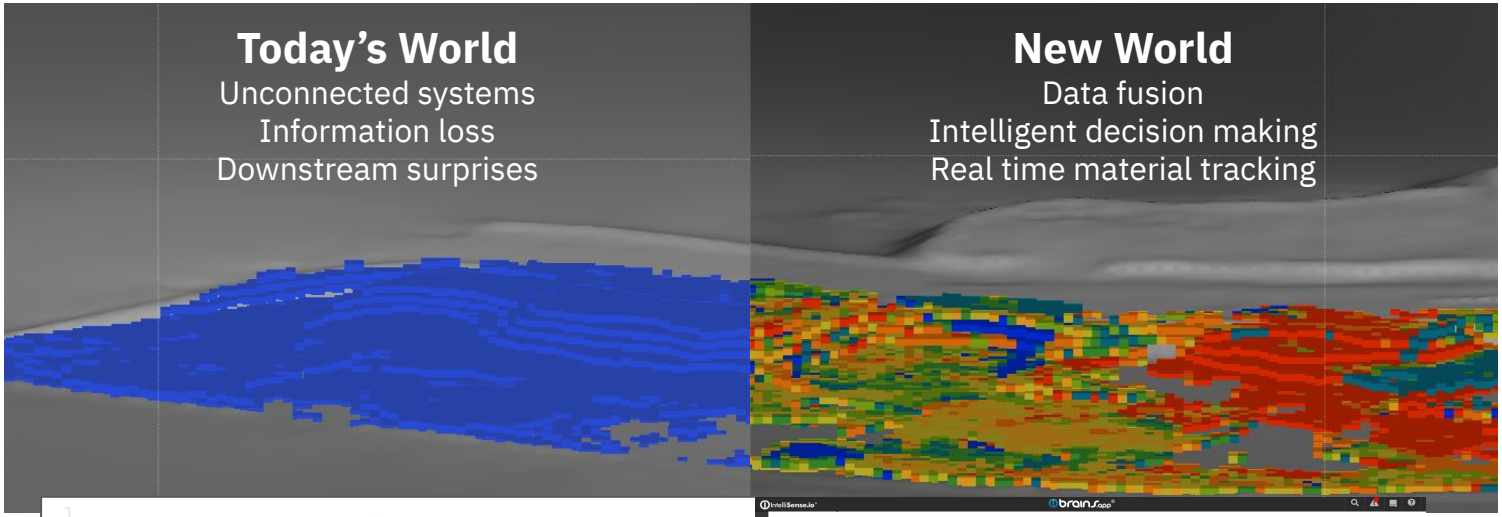
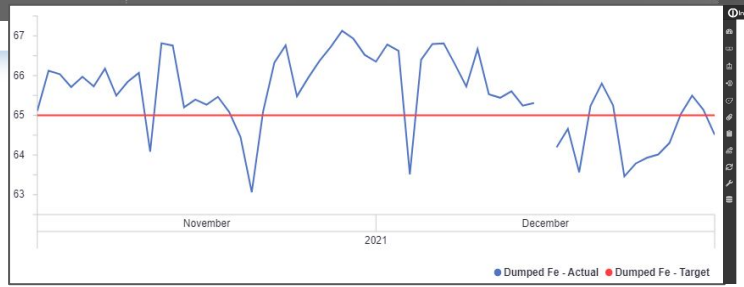
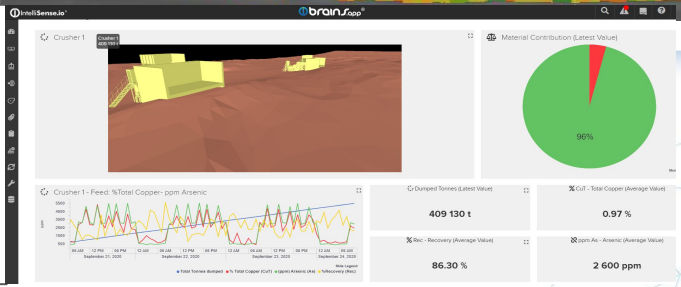
Stockpile & Inventory Optimisation







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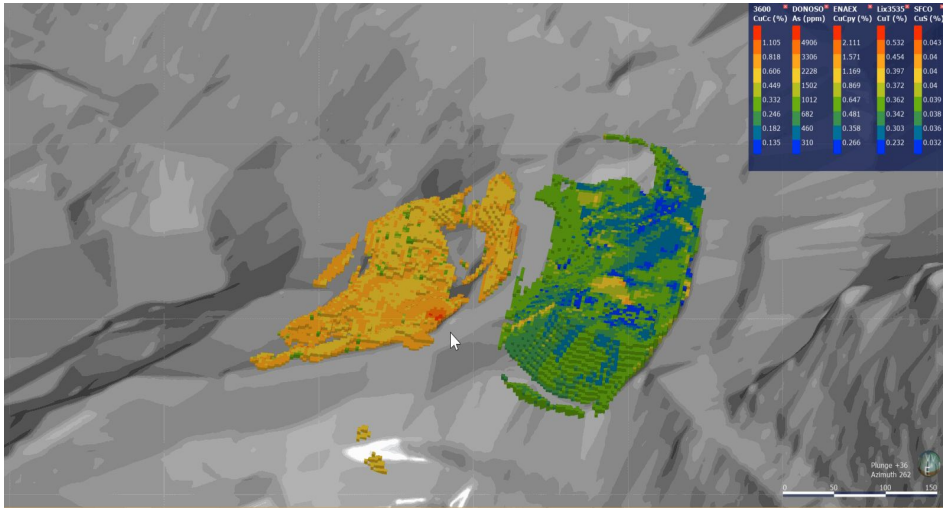
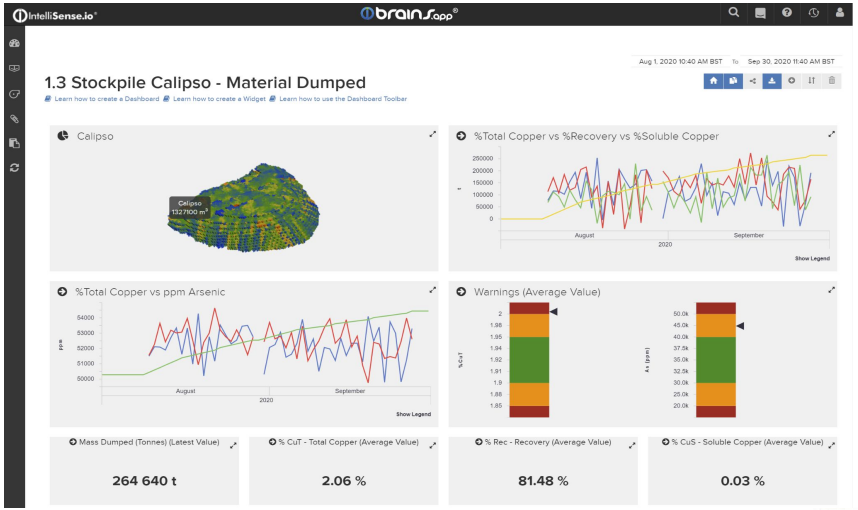
Solution

Stockpile and Inventory Optimisation Application





- Material Tracking
- Scan Management and Quality Checks
- GPS Smart Filling
- Dozer Modelling

- Stockpile Administration
- Dashboards and Reports
- Source Data Reconciliation
- Alerts Monitoring

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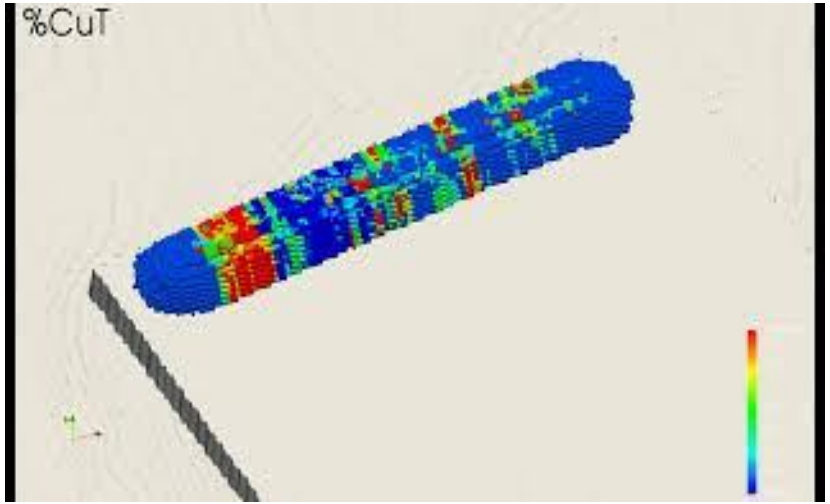
Delivering Insights to Operators in Real-time

Enabling the Right Decisions at the Right Time

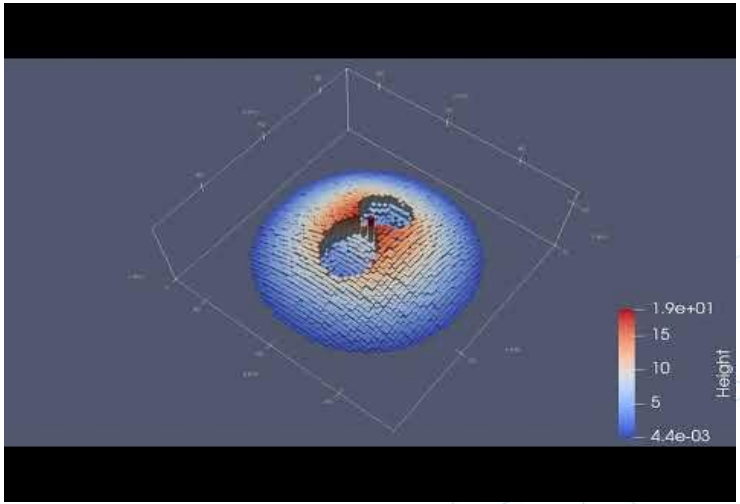
ROM and Production Stockpiles

- Material tracked with granular 3D block models
- Material handling & transport models



Crushed Ore Stockpiles

- Tracks flow rate and particle size distribution of the output material for single or multiple feeders.
- Monitors stockpile ‘total capacity’ with both ‘live’ and ‘dead’ zones, providing input into retrieval strategy.



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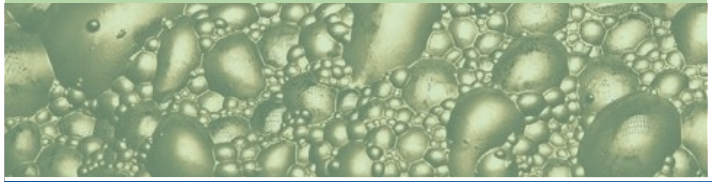
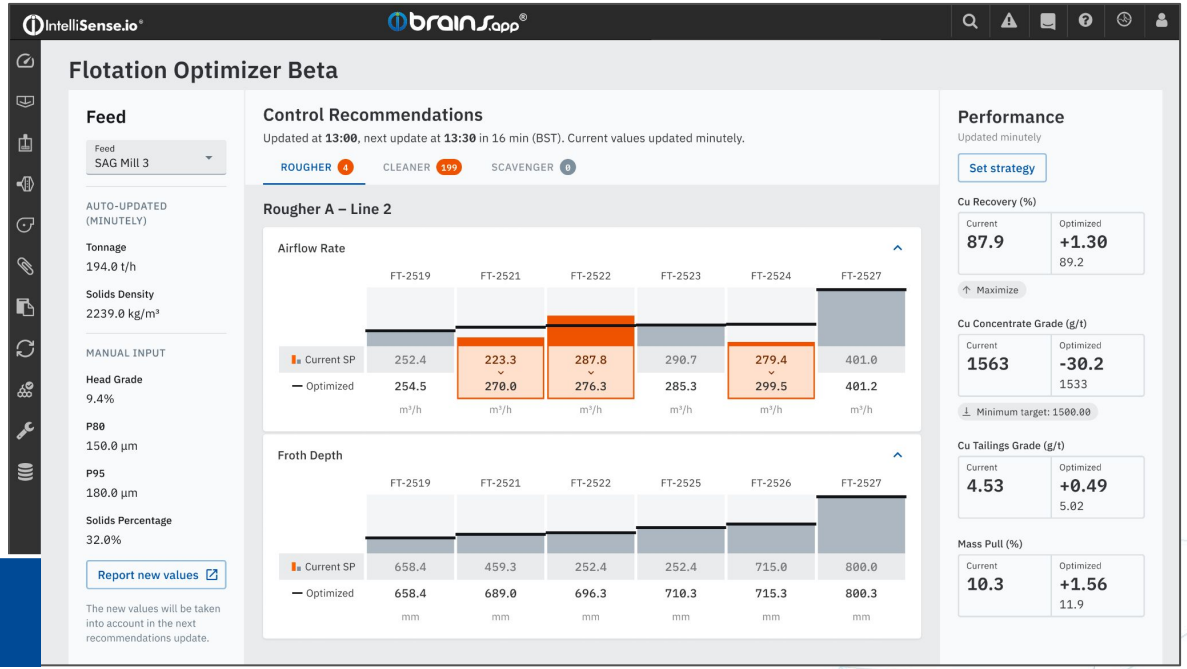
Flotation Optimizer UI

- **Optimizer screen designed for Metallurgists / Operators**
- **Permits execution of following tasks:**
  - Set Optimization strategy
  - Monitor Recommendations vs Actual Setpoints per each cell
  - Receive Alerts when the change of the setpoint is required



The Optimizer screen will be available once the Live data integration is configured



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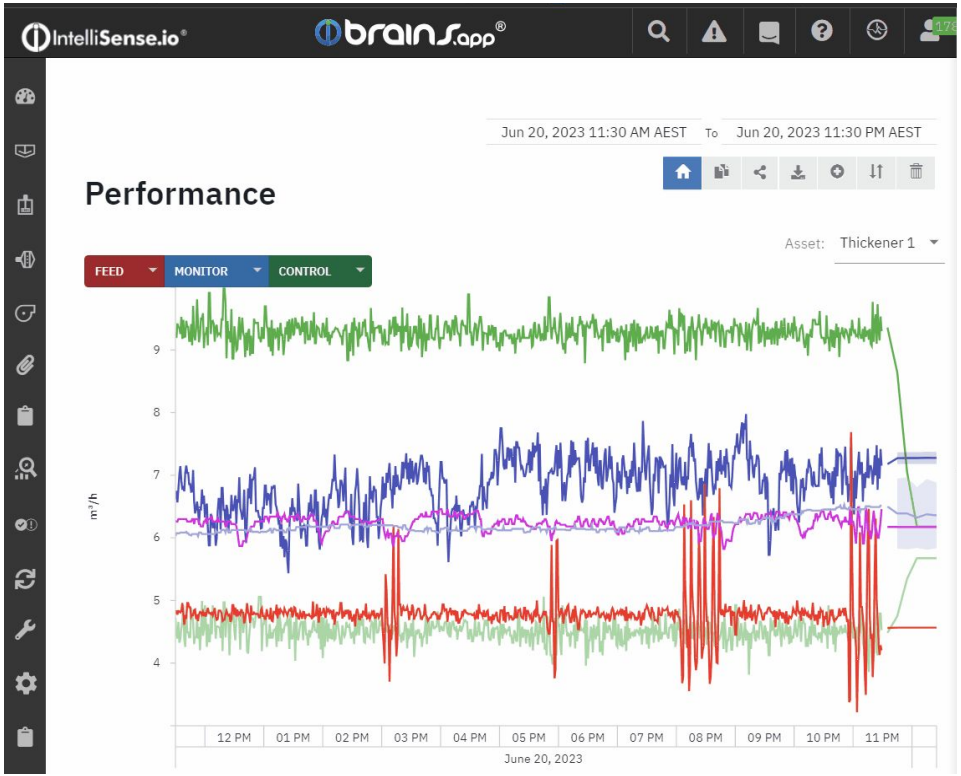
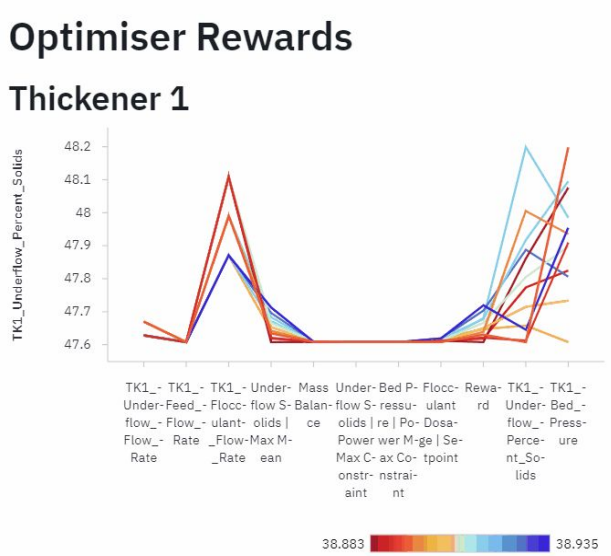
Real-Time AI Decision Optimisation

Predicting the Future





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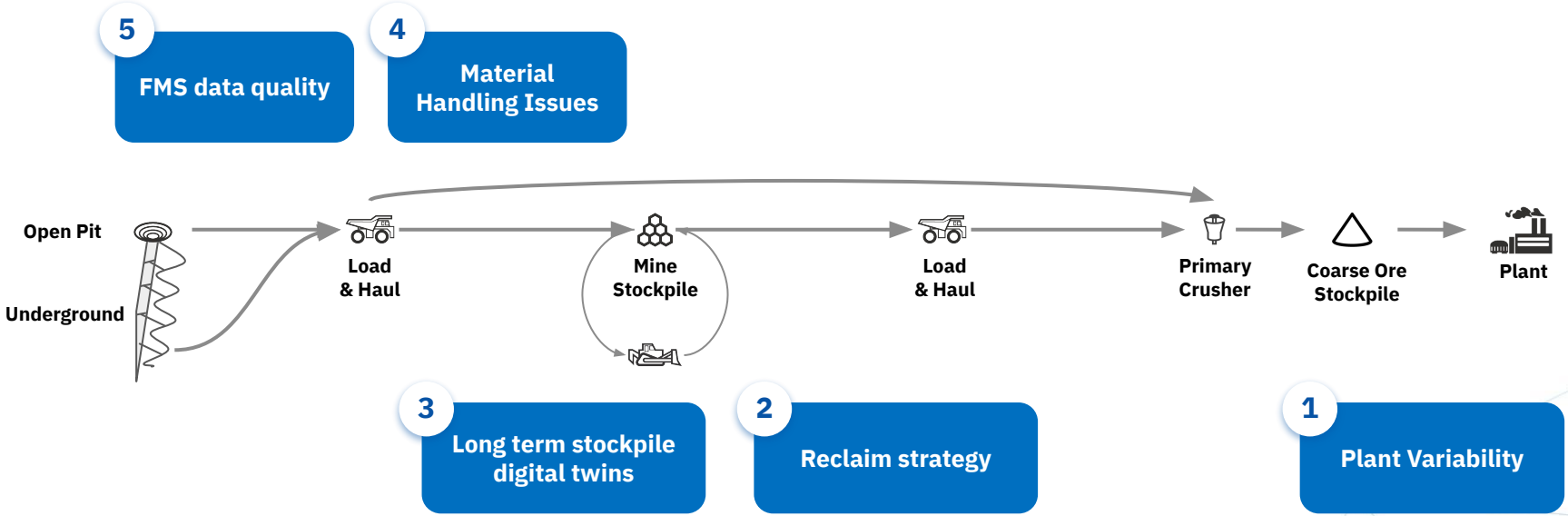
Value Case Studies

Stockpile Management



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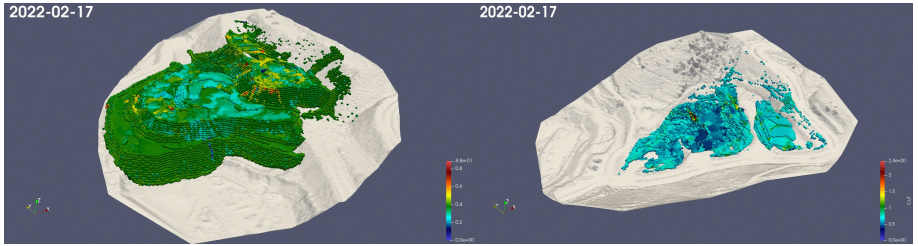
Case Study 1: Plant Variability

Large Copper Mine

Value Delivered

- **Decreased plant feed variability by 5-8%**
- **Improved plant setup for next incoming shift**
- **Better planning and reclaim strategy**



3D Digital Block Model of Stockpile exposing the dump locations and ore grade within the stockpile

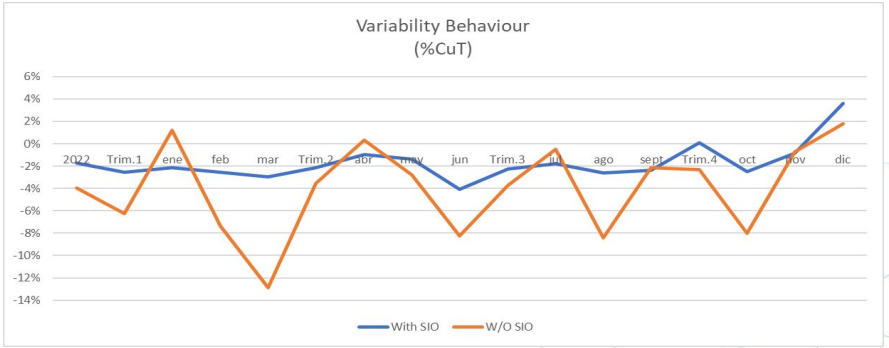
3D Digital Block Model of Stockpile exposing the material deposited by age range

Problem

- High variability of the material from different stockpiles being fed to the plant made it challenging to meet planning goals

Solution

- 3D Block Model of the Stockpile calibrated with topographical scans
- Material Tracking refreshed in real time as changes occur



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Case Study 2: Reclaim Strategy

Decreasing Variability of Plant Feed Contaminants and Improving Predictability

Value Delivered

Decreased Al2O3 variability by 20%

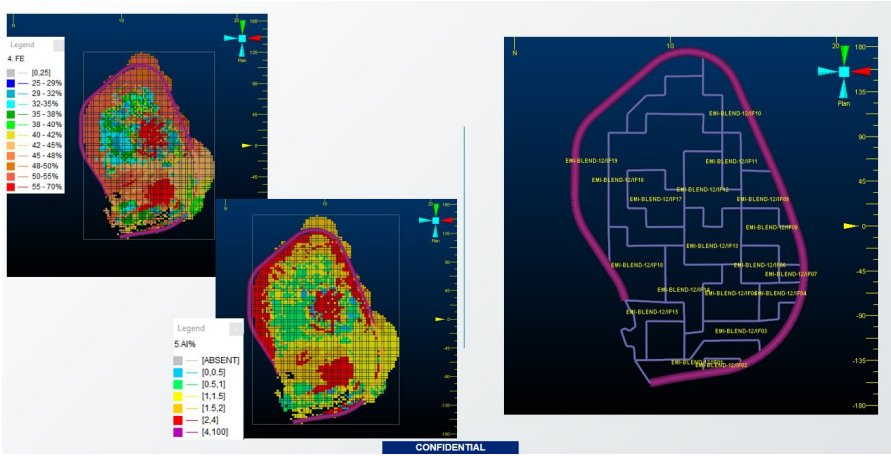
Improved downstream operations by reducing contamination

Problem

- Failure to meet product specification for alumina grade leading to penalties
- Heterogeneity was problematic due to the use of weighted averages in stockpiles
- High material variability & lack of predictability for plant feed led to suboptimal operation

Solution

- Stockpiles strategically reclaimed to homogenise plant feed using polygons based on 3D block models spatial distribution



Strategy for better reclaim and blend strategy based on 3D Stockpile models

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Case Study 3: Long Term Stockpiles

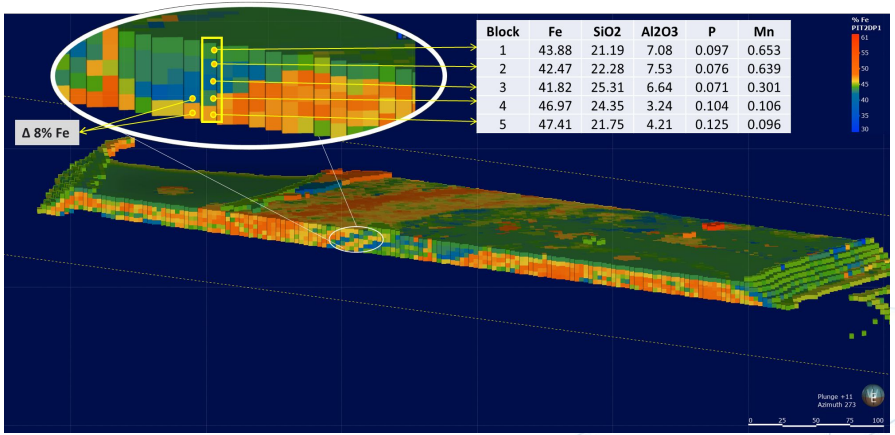
Large Iron Ore Operation

Value Delivered

Improved blending decisions

Improved material property analysis

Improved NPV estimates of long term inventory



Problem

- Millions of tonnes of ore with limited granular accuracy
- Weighted Average properties only

Solution

- Historical site FMS and survey scan data ingested by SIO to accurately model legacy long term Iron Ore stockpiles

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Case Study 4: Material Handling Issues

Dump and Load Data Missing

Value Delivered

Avoid 100k tonnes of Waste to Plant >$4M

20k tonnes of ore recovered from misdumps

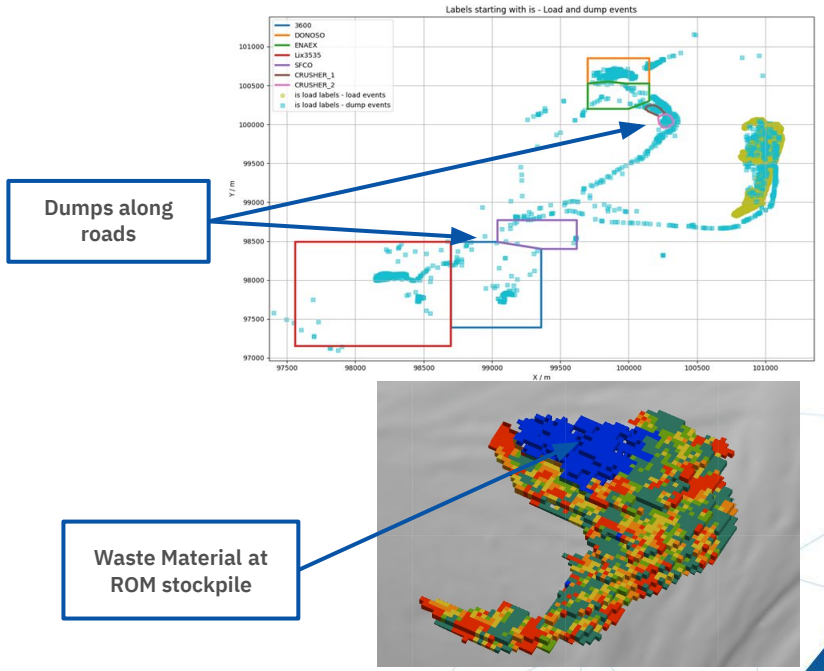
Material Movement accounting reports

Problem

- FMS label data quality issues leading to misdumps
- >100,000t of waste dumped on ore-grade stockpile during road widening construction
- >20,000t of ore was unknowingly used for building pit road platforms

Solution

- SIO 3D block model used to recognise deviations on stockpile & alerts used to highlight dumps that were out of range



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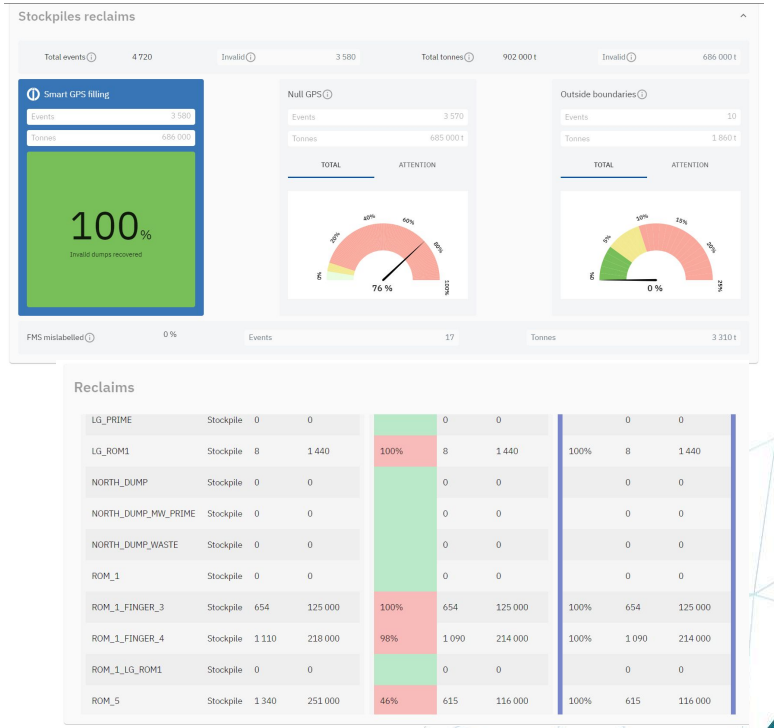
Case Study 5: FMS Data Quality

Persistent Missing Loaders GPS not Picked up by Data Engineers

Value Delivered

- **Improved data quality**
- **Improved reconciliation**
- **Data quality clearly displayed in brains.app**



Problem

- 30% of FMS load locations were missing
- Site unaware of the problem for 9 months

Solution

- Using the Spatial Data Quality screen, errors were spotted, analysed, & addressed
- Smart GPS filling kept robust real time results until data quality issue resolved.

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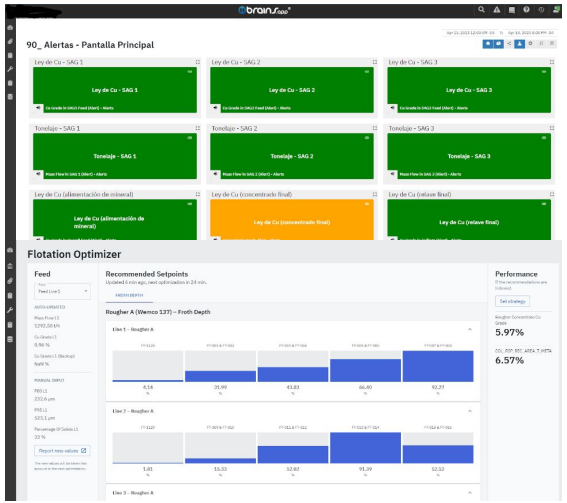
Commodity, Equipment & Circuit Agnostic: Chile Cu Case Study

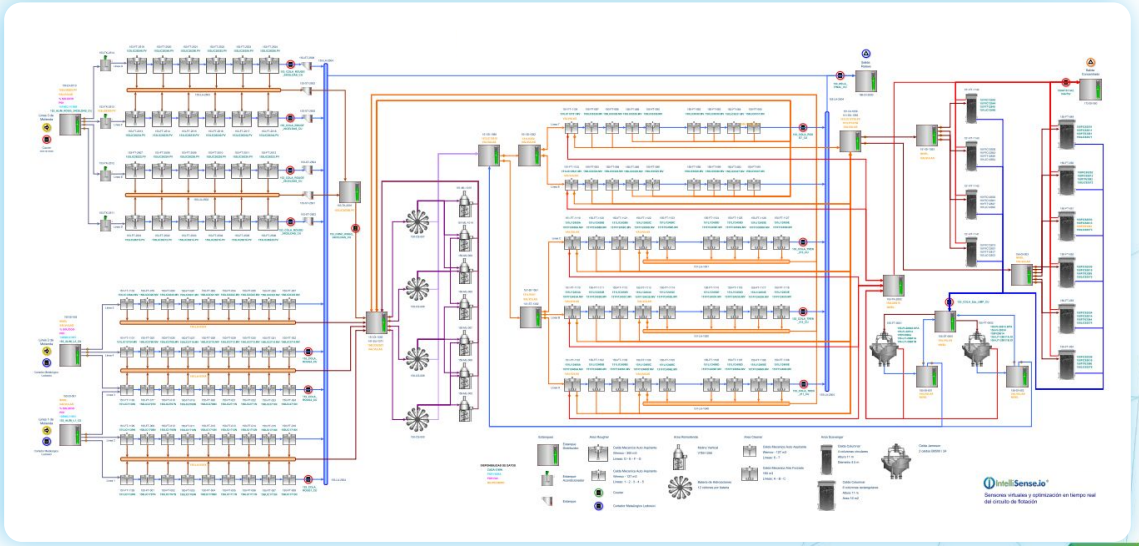
Challenge: Extremely Complex Circuit + Columnar Cells Performance

29 $3d^{10}4s^{1}$
Cu
Copper
63.546

Value Delivered

- >$38M potential annual gain
- >1% increase in overall Cu recovery
- Visibility of underperforming cells within circuit
- More minerals for the energy transition





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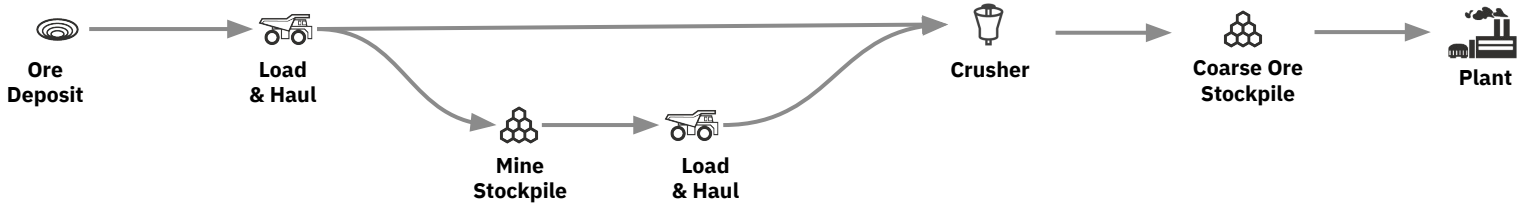
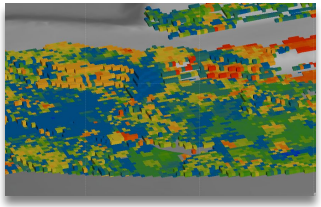
Recap

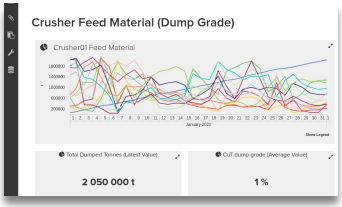


Material Movements

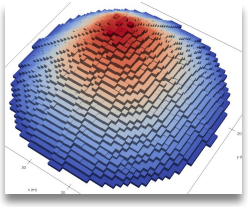
Stockpile 3D Block Models



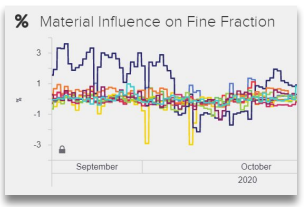
Reclaims & crusher feed



Coarse Ore Stockpiles



Tracking & influence into the plant



Mining Team

Real time 3D stockpile block models tracking grade and full spectrum of material properties

Geological modelling & mine planning **software compatible**

Data quality analytics and alerts

Met Accounting

Centralized material tracking across the mine value chain

Material property predictability, Planned vs Actual accuracy

Out of spec material analytics and alerts

Processing Team

Improve **blending decisions**

Understand **plant performance**

More **accurately reconcile**

Improved **compliance to plan**

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Where Are We Doing This?

Global Footprint, Cross Commodity, Large & Complex Sites

Nickel

Diamond

Copper

Iron

Platinum

Gold

Lithium

Rare Earth

De Beers
A DIAMOND IS FOREVER

NEVADA GOLDMINES

RioTinto Kennecott

POLYMETAL INTERNATIONAL PLC

27 Deployments Globally

Newmont Teck

ESCONDIDA | BHP

CSN
Companhia Siderúrgica Nacional

GLENCORE

COLLAHUASI

ANGLO AMERICAN

BHP Evolution MINING

LOS PELAMBRES
ANTOFAGASTA MINERALS

AngloAmerican
SISHEN MINE

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Real-time Scientific AI APPLICATIONS

10 Years in Mining
105 Employees
200,000 Person Hours of R&D
120 Person Years of R&D
BASF Strategic Investor
23 Technology Patents

EXAMPLE OF SITES DEPLOYED

- **Bakyrchik** (Polymetal)
- **Casa de Pedra** (CSN)
- **Collahuasi** (BHP)
- **Cortez** (Nevada Gold)
- **Cowal** (Evolution)
- **Kennecott** (Rio Tinto)
- **KCC** (Glencore)
- **Kolomela** (Anglo American)
- **Los Pelambres** (AMSA)
- **Minas Rio** (Anglo American)
- **Mogalakwena** (Anglo American)
- **Penasquito** (Newmont)
- **Quellaveco** (Anglo American)
- **QB2** (Teck)
- **Sishen** (Anglo American)

Gartner COOL VENDOR 2022

Gartner® Cool Vendor™ in 'Simulation for AI'

INVEST METS

'Best Scale Up' 2024 Nominated by our Customers

NTA National Technology Awards 2022 WINNER

AI Solution of the Year

"The system has exceeded expectations and is now being implemented at all operations"

–Head of Mining Global 'Tier 1' Miner

IMPACT OF REAL-TIME SCIENTIFIC AI APPLICATIONS

250 tonnes ($2M) of additional Copper production per week

10k tonnes ($80M) of increased Copper production per year

1.5% increase in Gold recovery from flotation scavenger circuit

16% reduction in chemical use

$1.3M (1%) increase in grinding throughput

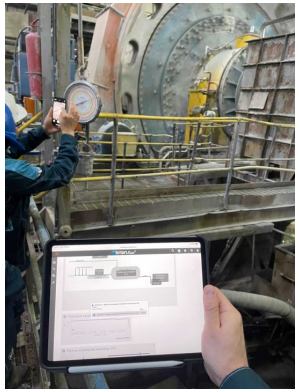
8% saving in acid consumption

5-8% decreased feed variability to plant

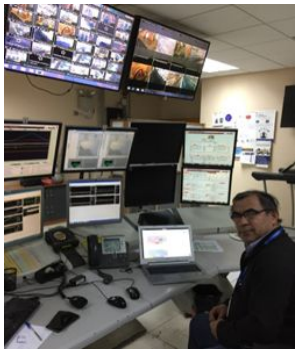
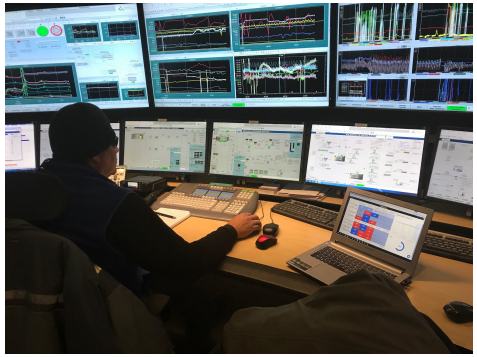
3.5GWh (2480 tCO2e) reduction in energy

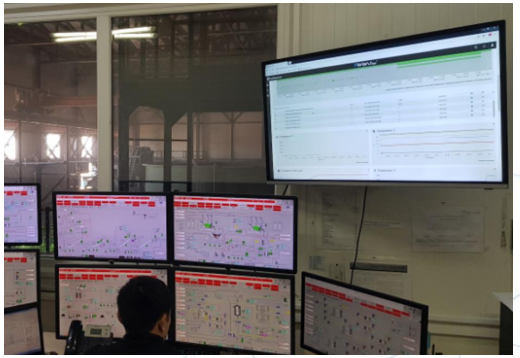
$38M (1%) improvement in metal recovery

Real-Time Scientific AI - In Action







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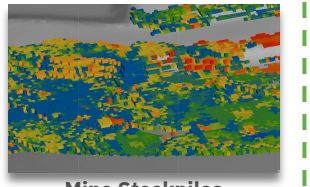
Australia - Gold Recovery Optimization Solution

Existing IntelliSense.io App at Major Gold Miner

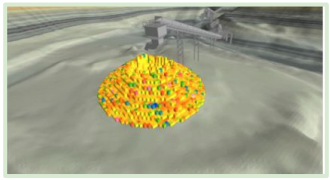
Material Tracking & Reconciliation with Real-Time Optimization Solutions

Currently being implemented
COS + Flotation + Leaching

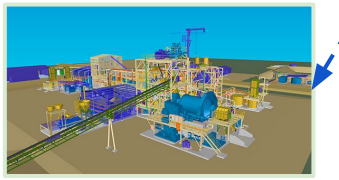
Non Linear Value - achieved with upstream and downstream Apps **"talking to" and influencing** each other via interconnection with ***Real-Time Material Tracking, Influence and Reconciliation***



Mine Stockpiles



Coarse Ore Stockpile (COS)

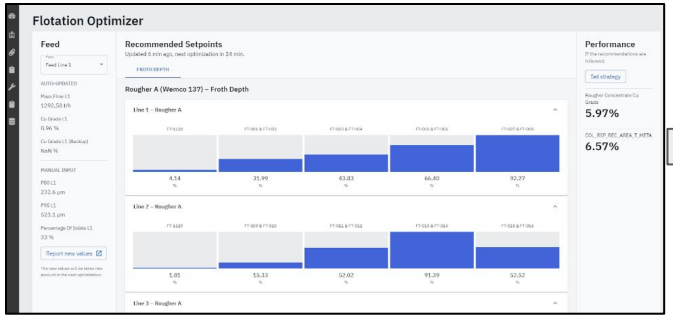


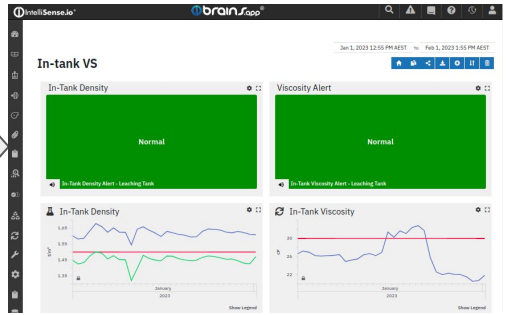
Plant: Flotation + Leaching

Beneficiation Solution

Recovery Reward

Plant: Flotation + Leaching





Ball Mill Cyclone Overflow to both CIL Circuit Discharges

- Flotation Cells/Banks
- Vertical Stirred Mills
- Thickeners
- Concentrate CIL
- Flotation Tails CIL
- Cyclones

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Thank You !
Q&A

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