

CRC CORE

Optimising Resource Extraction



invent



integrate

implement



introduce



Australian Government
Department of Industry,
Innovation and Science

Business
Cooperative Research
Centres Programme

CRC ORE

Ben Adair - CEEC

27 August, 2018 Brisbane

A Collaborative Research Centre focused on Optimising Resource Extraction in the Minerals Industry



Funded

Funded by the global minerals industry and the federal government
Independent Not for profit



Term

Commenced mid-2010,
Awarded a further 6-years funding (~A\$112M)
until mid-2021



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OUR ESSENTIAL PARTICIPANTS

Mining



GLENCORE

Teck

BHP



Sumitomo Corporation



ANGLOGOLD ASHANTI

Mets

HATCH



Researchers



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HOW DO WE OPTIMISE RESOURCE EXTRACTION?

GRADE ENGINEERING

Separate ore from waste much earlier in the mining process

INTEGRATED EXTRACTION SIMULATOR

Process simulation across the value chain

TECHNOLOGY DEVELOPMENT & TRANSFER

For benefit of Australian mining industry



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TRANSFORMATIONAL IMPROVEMENTS IN MINING

There are plenty of opportunities to improve the performance of our existing mining operations

1. Declining grades are not inevitable if you reject gangue before processing e.g. through Grade Engineering®
2. Remove the “silos” and run operations completely differently
 - Learn from other industries – modular, flexible and focus on real value
 - Defy convention and run your circuits with real time sensors
 - Apply latest technology innovations quickly
3. Step changes in Energy, Water and Production



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APPROACH TO INNOVATION

- Lots of point solutions – integrate off the shelf technology
- Supercharge Grade Engineering[®] with a suite of separation levers & new approaches to mine extraction – the best “new” mine is your existing operation
- New comminution devices – selective breakage
- Liberate only enough to separate (we currently overgrind everything using 2% of the worlds electricity and at <10% efficiency!)
- New innovations in water use and e.g. dry stacking of tailings and target “closed loop” water use



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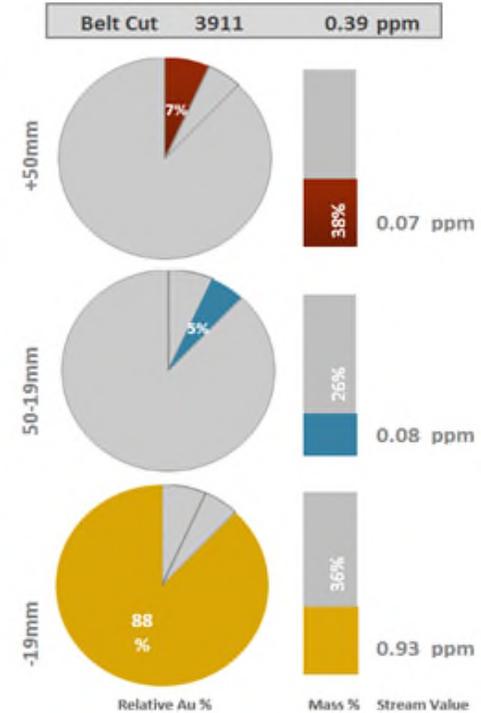
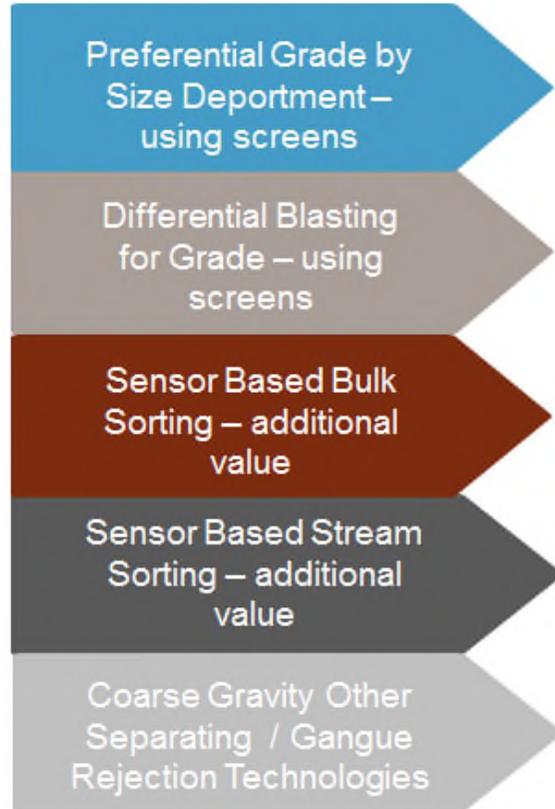
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SEPARATING ORE FROM WASTE – GRADE ENGINEERING®

Grade Engineering® is an integrated approach to coarse gangue rejection matching separation technologies to ore specific characteristics to unlock value.

Grade Engineering Technologies



A simple example - data from operating Au mine



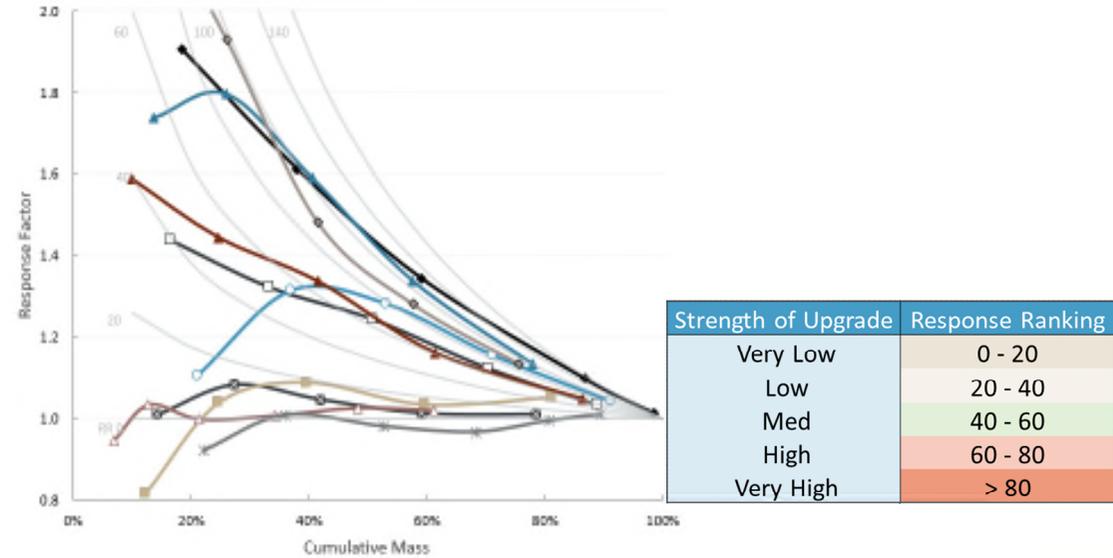
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GRADE ENGINEERING CHARACTERISATION

- Testing rock properties for Natural Grade by Size Responses involves screening samples into a number of different size fractions and measuring the grade and mass of each.
- The test results can be displayed as **Response Curves**.



Mine Samples (~30t)



Sub-samples (~4t)



Laboratory Screening



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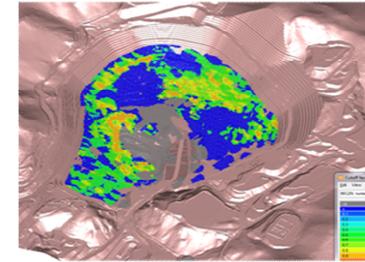
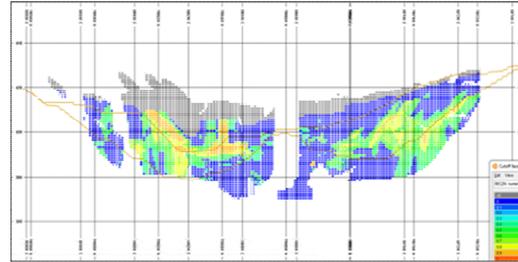
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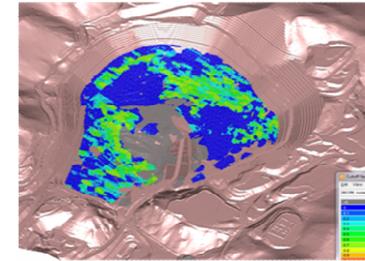
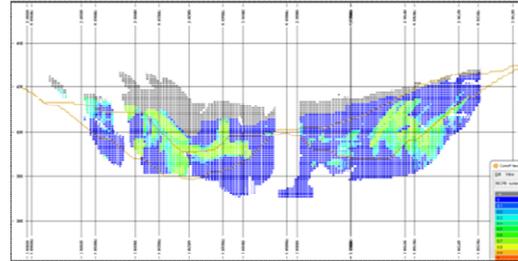
THE SIMPLEST LEVER: SCREENING - A BILLION DOLLAR PRIZE

- Amenity testing indicates low waste halo (blue) and mineralised waste stockpiles show high promise for upgrading with grade engineering
- A full scale production trial will now commence
- The “size of the prize” is to reclassify these targets into ore feed – up to 1B\$ in value

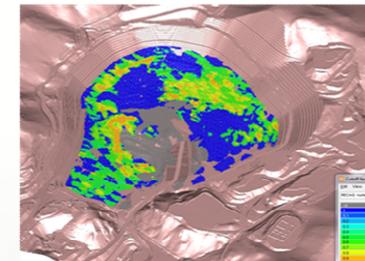
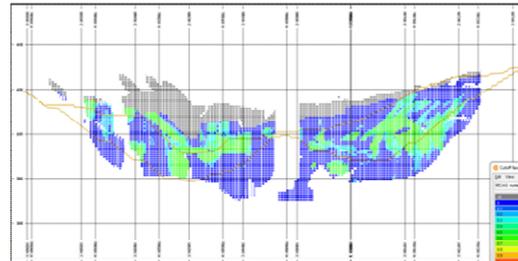
Zn Recovery



Pb Recovery



Ag Recovery



Mobile screen ST2.8 equipped with METSO Metrics follow up system and conveyor scales



Screening plant operate ~450tph required to operate

New Lokotrack unit manufactured for MSC Production Trial



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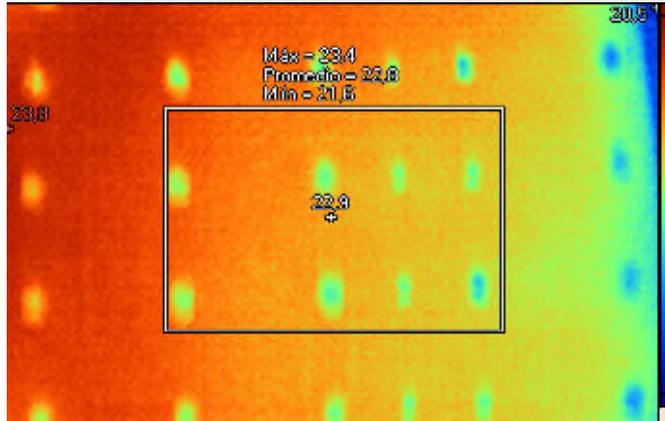
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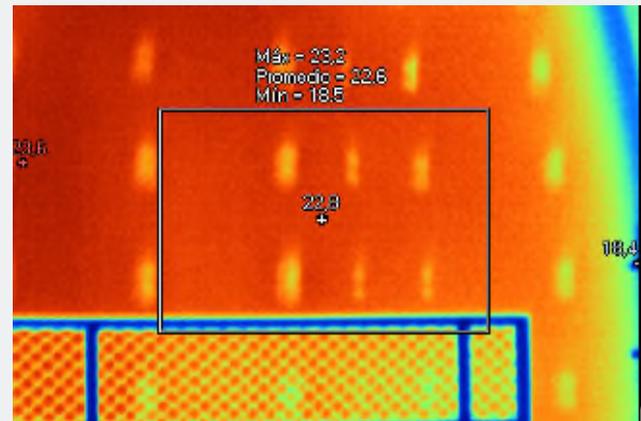
MINERA SAN CRISTÓBAL S.A.

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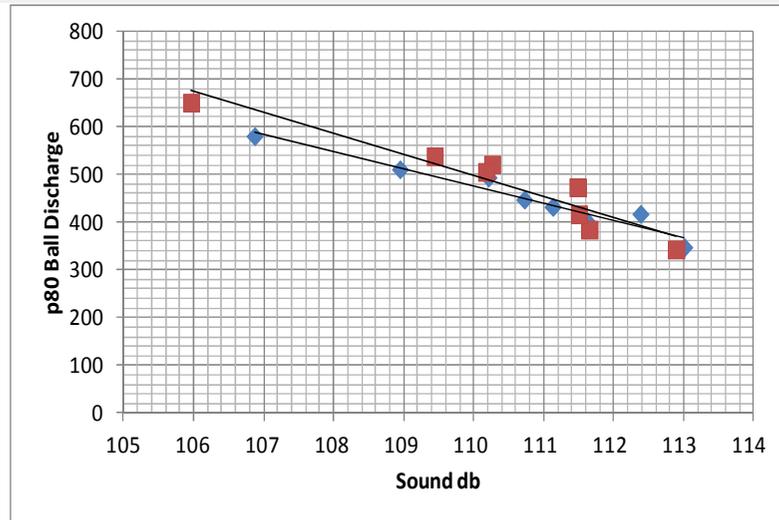
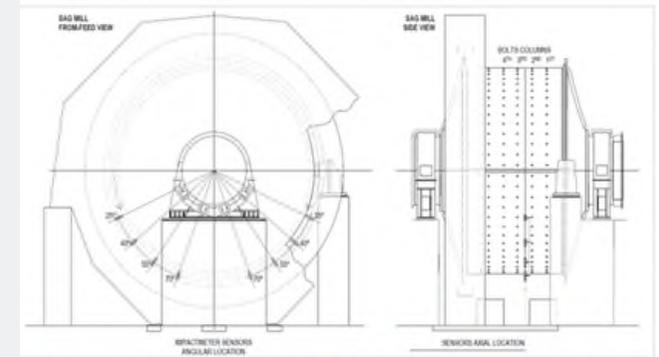
OPERATIONAL EXAMPLE – RUN THE COMMINUTION SYSTEM DIFFERENTLY



Feed thermogram



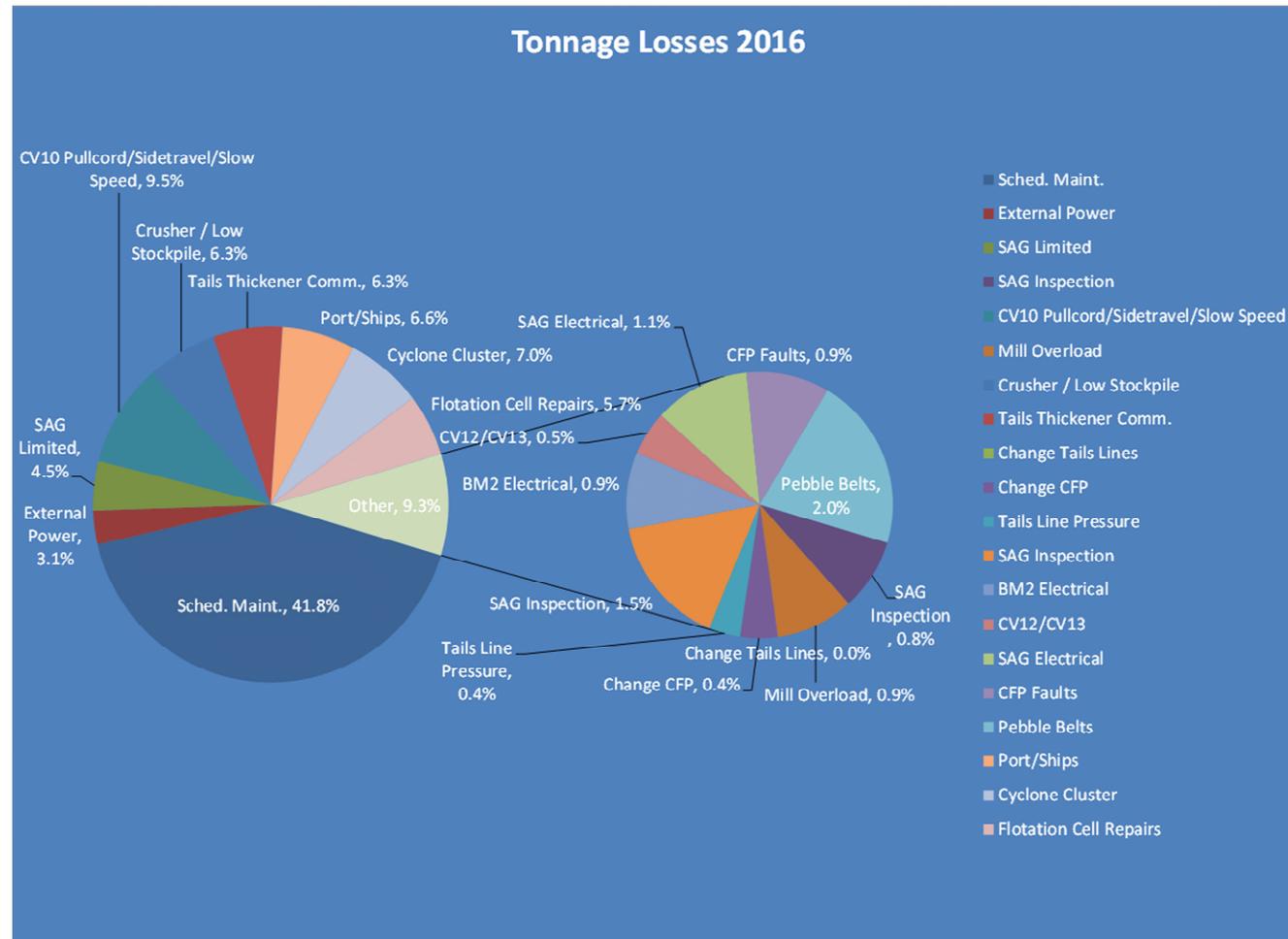
Discharge thermogram



IMPROVING PERFORMANCE

- “Modular” Innovation – “plug and play”
- New innovations quickly deployed and tested
- Approach is common outside the mining sector
e.g. Ikea, Coca Cola, Nestle etc.
- Equipment bristling with sensors – we measure what we do
e.g. opportunity costing

Year	Tonnes	Value
2015	1,282,340	\$ 57,978,758
2016	1,127,829	\$ 68,758,285
2017	780,850	\$ 51,320,083
Total	3,191,018	\$ 178,057,125

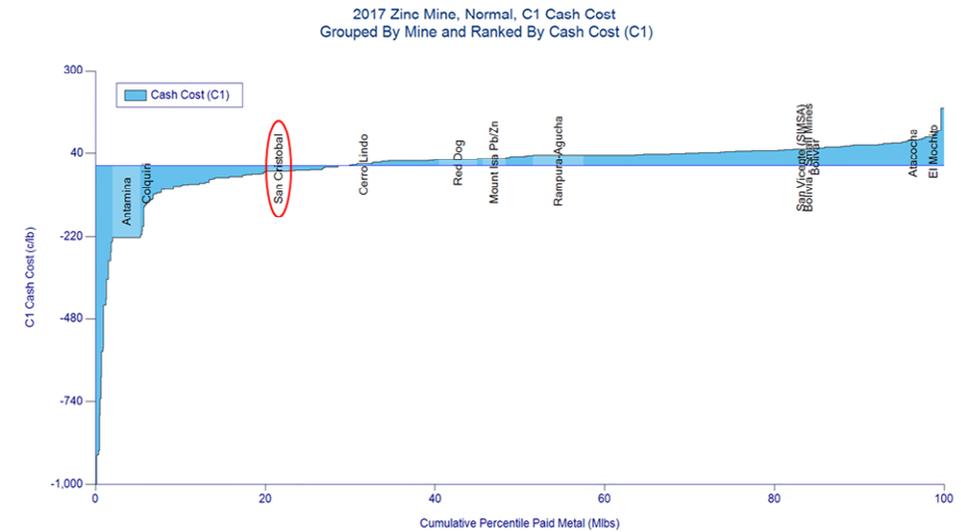


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A step change in five years – from Q3 to Q1 with some of the lowest head grades in the Industry



Source: Wood Mackenzie Ltd, Dataset: 2017 Q3

CLOUD BASED IES MASS SIMULATION – THE “ANGLO CHALLENGE”



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HOW WE DELIVER IES

Equipment/Process Models



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CRC ORE Develops the Platform Not The Models

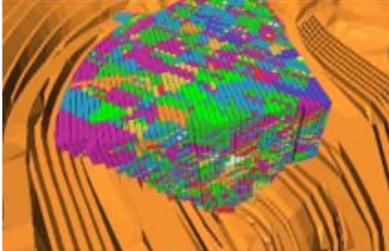
Cloud hosted - IES is an open platform on which researchers, miners and consultants can develop models.

In-field Testing



CRC ORE DELIVERY THEMES - INTEGRATED SOLUTION STACKS

DEFINE | EXTRACT | DELIVER



GE-enabled block models and mine plan optimisation



Instrumenting the bench with on-line data flows



Crushing and coarse separation in the pit

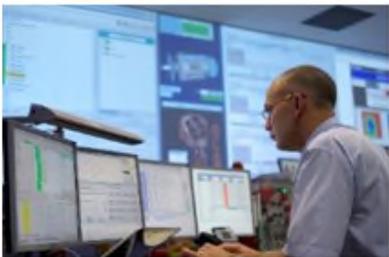


Combining Grade and Throughput Engineering



On-line sensing and separation of coarse streams

LIBERATE | RECOVER | CONTROL



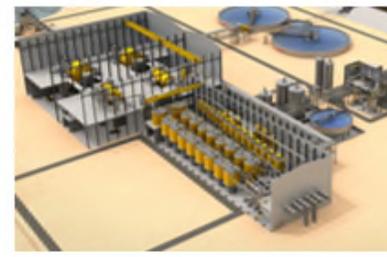
Sustaining 'Whole of System' value



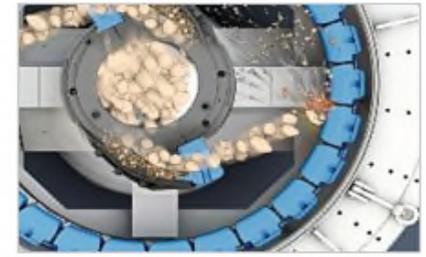
Optimising system value for energy, water and environment



IES-enabled integrated simulation across value chain



GE-enabled circuit design and advanced process control



Energy efficient enhanced coarse liberation



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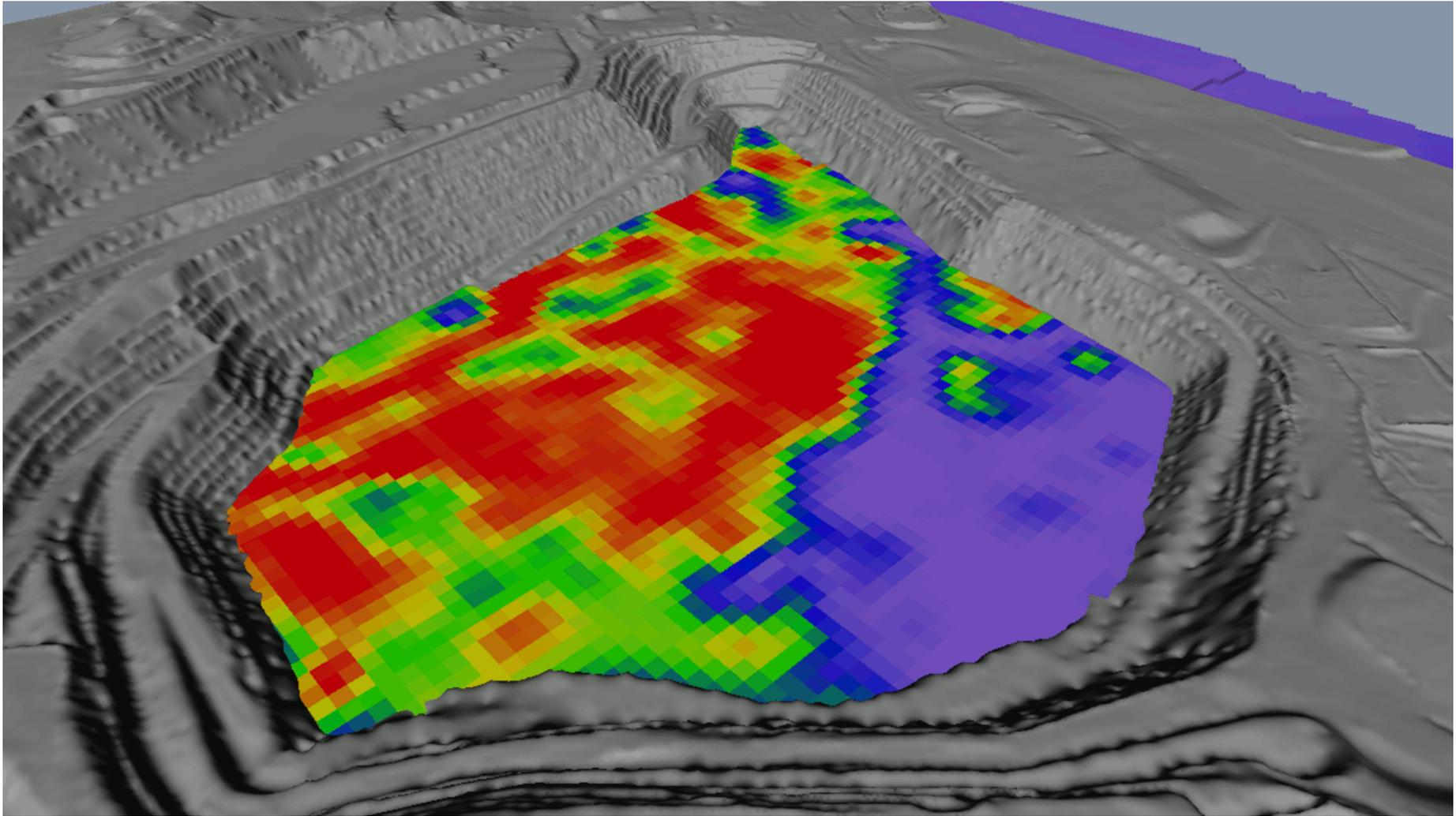
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Different Interests for each of our Participants e.g. Orica



E.G. INSTRUMENTING THE BENCH DELIVERY THEME



NOW AN ACTIVE CONSORTIA: ORICA, IMDEX, METS IGNITED, TECK AND ANGLO-AMERICAN

TRANSFER QUICKLY: CLUSTERS e.g Kalgoorlie-Boulder Mining Innovation Hub

Its Purpose

Promote collaboration partnerships

Independent assessment of technology

Facilitate site demonstration and adoption

Professional Development

Promote innovation (with MRIWA, METS Ignited and others)

The Hub will be run as a node of CRC ORE for two years



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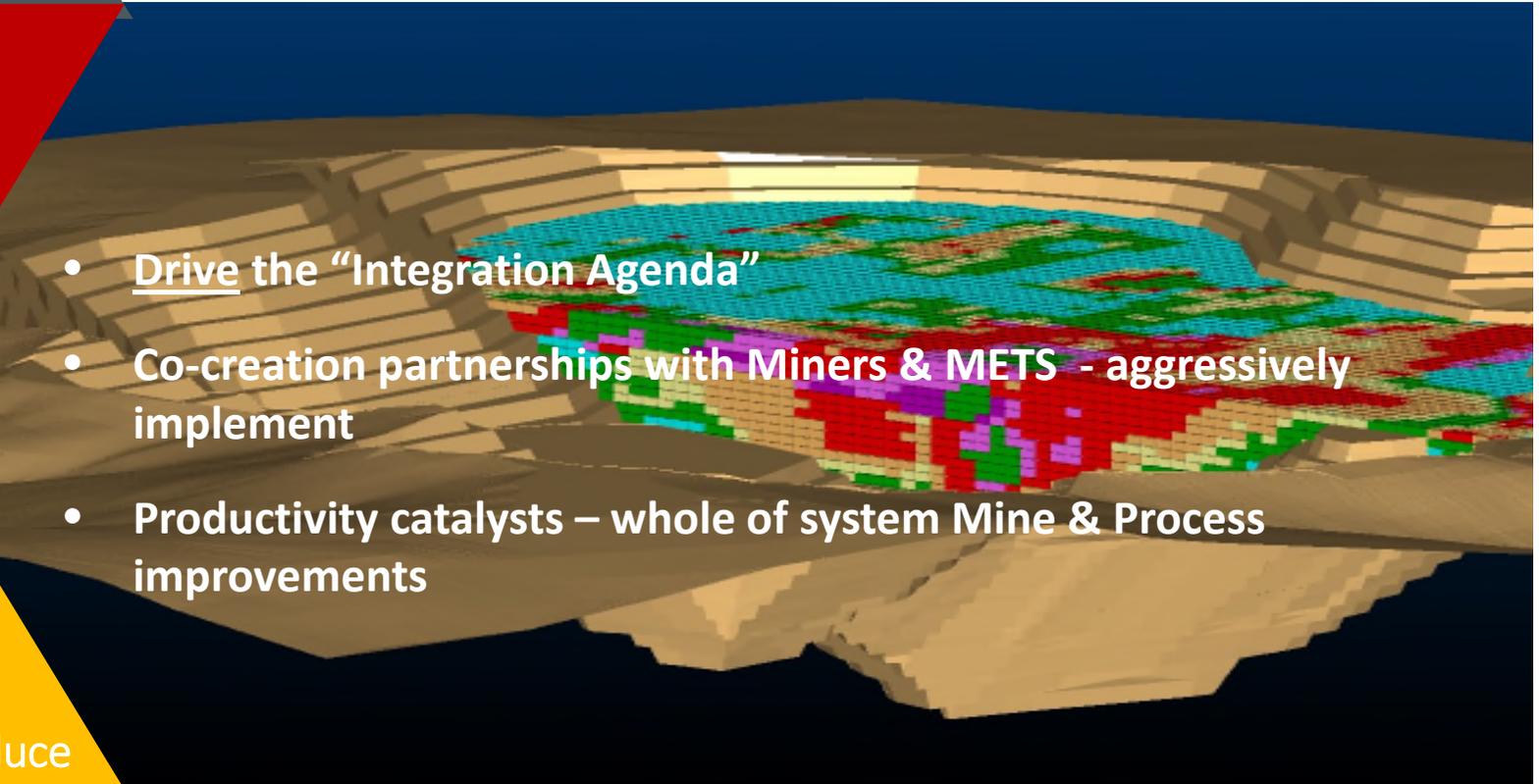
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- 
- Drive the “Integration Agenda”
 - Co-creation partnerships with Miners & METS - aggressively implement
 - Productivity catalysts – whole of system Mine & Process improvements

1. To change the Energy, Production and Water signatures of our Miners Operations
2. To provide new business opportunities and markets for our Mets Participants
3. To provide an implementation pathway for our Research Community