

+ Digital Mining Overview

Unleashing the Value of Data



Optimizing Mine Performance Through Digital Innovation Seminar, October 18, 2017

Alvaro Roza, Global Director, Smart Industries

Industry is now talking about innovation and digital, not just cost cutting



AngloAmerican

- “Global mining stocks have lost \$1.4 trillion of market value since 2011... more than the combined value of Apple, Exxon/Mobil and Google.
- We all need to innovate in the widest sense of the word... We need to reset our industry



BARRICK

- Harnessing the potential of digital technology will unlock value across our business, helping us grow our free cash flow per share... Just as importantly, digital technology will allow us to reduce our environmental impact and be even more transparent with our local partners—especially indigenous communities, local governments, and NGOs

BHP

- Big Data is being used for predictive analysis crunching mountains of digital information to forecast how groups of people and natural systems behave (and for us – it’s taking productivity to new levels at our operations!)

RioTinto

- There has been a significant deterioration in the macro environment. So further pre-emptive actions are required to protect shareholder value
- “Innovation is not an optional extra. If you haven’t got innovation in your business, before long you’re not going to have a business”

We are seeing changes but Climate and Communities are also changing

In mining-affected communities, water is becoming more precious than gold



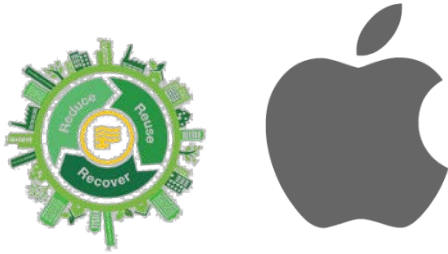
Towards Zero Water



It might not be probable, but if we could figure out in the next 10 years how to crush and grind rock without using water and to leave mine dewatering water in the ground, those would be the last remaining things we have to figure out.

and New Generations are also signaling further market changes

Signal of change
Apple commits to zero mining



In its newly released 2017 Environmental Responsibility Report, the Cupertino company--Apple--says its goal is to "***stop mining the earth altogether***" for rare minerals and metals used to make its devices.

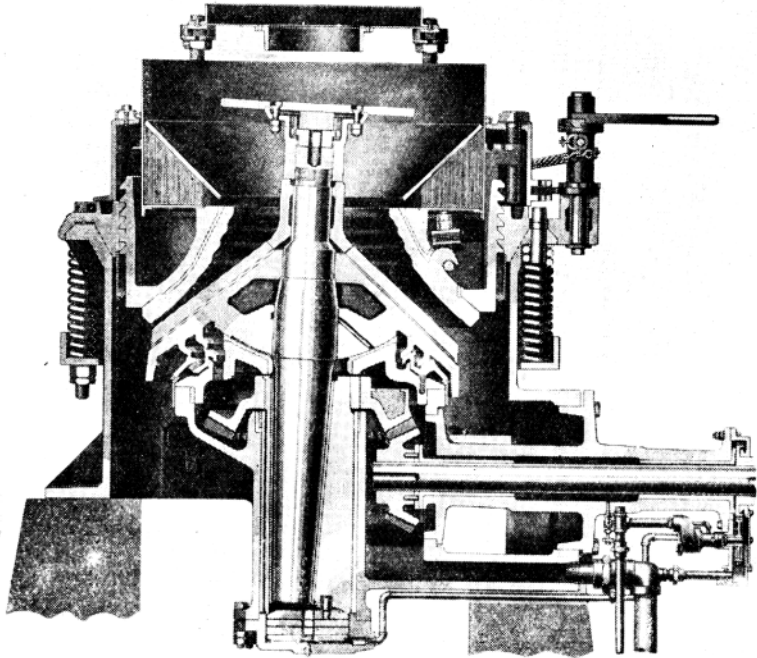
Alternative new products



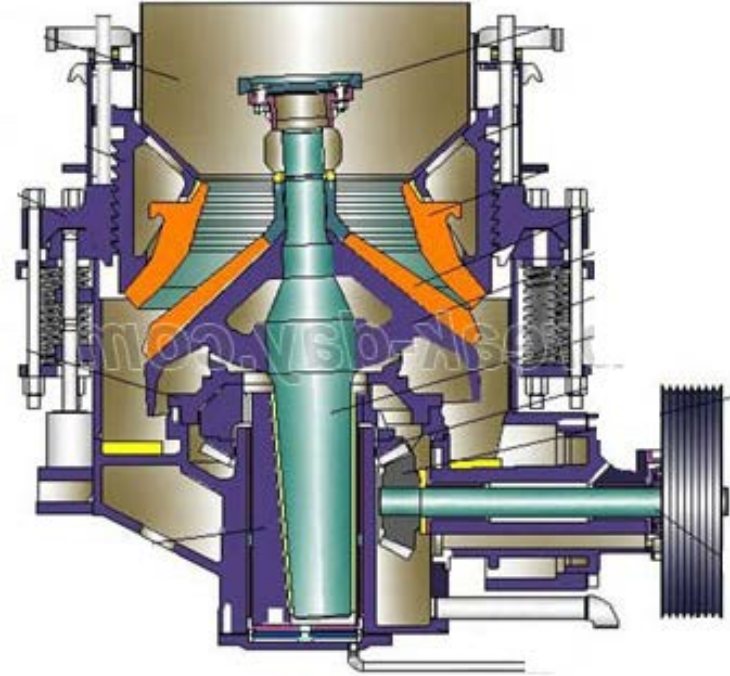
Fascinating carbon concrete, an alternative to steel enforced concrete

Worldwide, the building industry uses around 160 million tones of steel each year to reinforce concrete

Yet Mining Innovation still looks like this...



1935



2017

Shifting from technologies that destroy value...



Detailed Dashboards



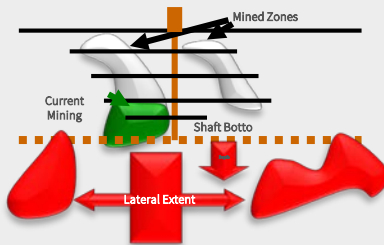
400t Trucks



Drill – Blast - Haul



Chasing grade at depth



Mining below^m shaft bottom



Super size mills

Compass

Mining
Intensity



Labor
Intensity



Energy / Water
Intensity

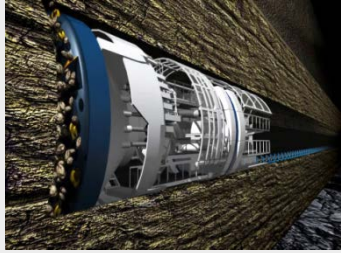


Capital
Intensity



Seemingly logical tactics that destroy long term value

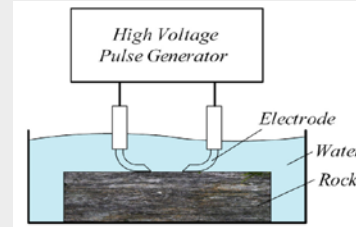
...into technologies that add value



Continuous Mining



Hatch In-Situ Mining



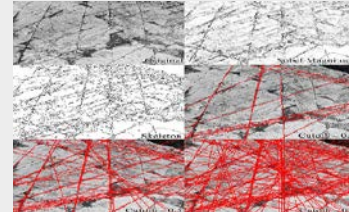
Electric Pulse
Fragmentation



Raglan Wind Power

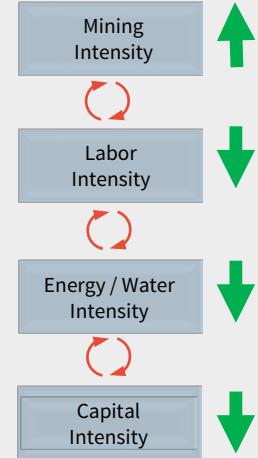


Hatch "Digital" Mining



Hatch Mine to Mill Optimization

Compass



Technologies that change the flowsheet

Changing the way we execute projects

A Furnace Rebuild Case Study

4D-CASE STUDY

SAFETY

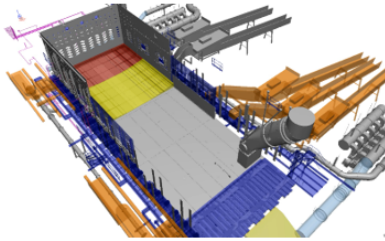
SCHEDULE
OPTIMIZATION

COLLABORATION

VERSATILITY

DELIVERING
VALUE

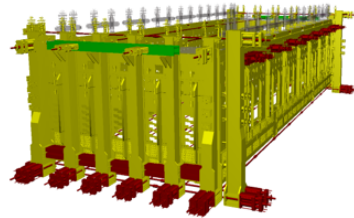
Unforeseen Circumstances and Unexpected Value



- Demolition Contractor delays
- Recovery Plan
- Stakeholder Buy-In

Materials Management

- All 3D components identified and tagged
- Materials sorted into work packages
- **Status Visualization** by component or Work Packages
- Used for Go/No Go for contractors to start work



■ NOT ON SITE
■ PARTIALLY ON SITE
■ ON SITE

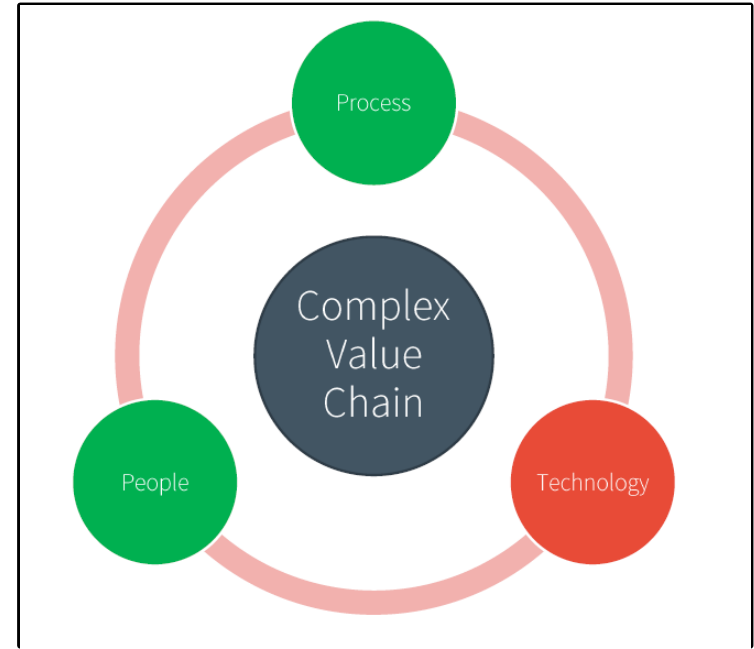
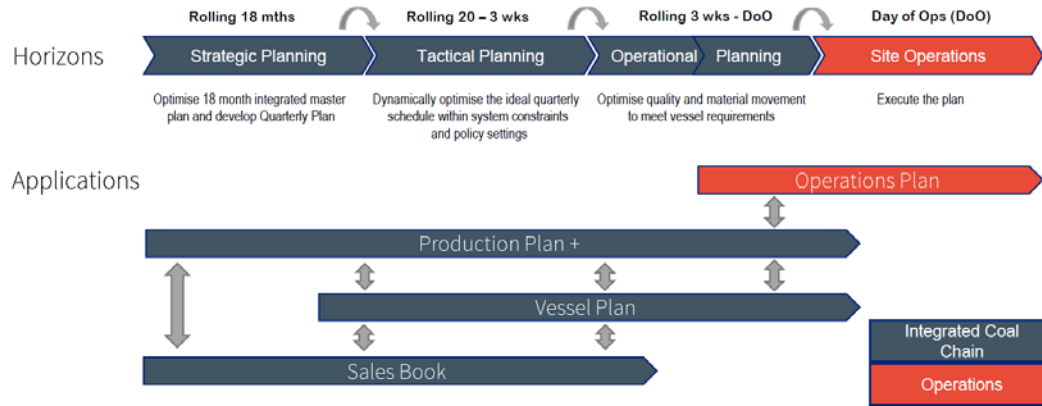
HATCH

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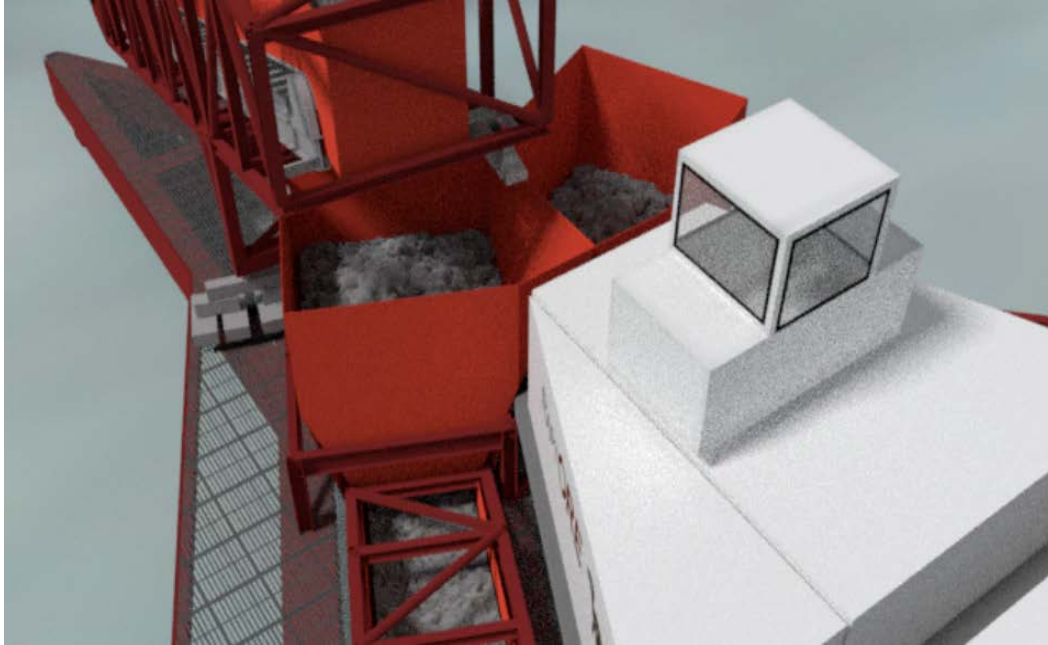
Changing the way we operate

An Integrated Planning Case Study



Transforming Mining

An Equipment Technology Case Study



- Full Autonomy
- Predictive, operational process optimization
- Early ore quality assessment and disposition close to the face
- Reduced ore grade variability at downstream processes
- Maximises Shovel up-time
- Minimises double-handling of waste
- Enables different value strategies (e.g. optimizing reserves, increase grade etc.)



“Addressing Digitization in Mining by increasing the use of data is a great start and will lead to great improvements but they may not be enough to make a long-term difference for the Industry.”



To make Mining sustainable, Digitization needs to ultimately lead to a step change in Mining Technologies, both equipment and processes or in the business models with clients, communities, partners”



Thank you.

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