# Teck

## Innovation

### April 4, 2018

Kalev Ruberg, Vice President, Digital Systems and Chief Information Officer Greg Brouwer, General Manager, Technology and Innovation



# Forward Looking Information

Both these slides and the accompanying oral presentation contain certain forward-looking statements within the meaning of the United States Private Securities Litigation Reform Act of 1995 and forward-looking information within the meaning of the Securities Act (Ontario) and comparable legislation in other provinces. Forward-looking statements can be identified by the use of words such as "plans", "expects" or "does not expect", "is expected", "budget", "scheduled", "estimates", "forecasts", "intends", "anticipates" or "does not anticipate", or "believes", or variation of such words and phrases or state that certain actions, events or results "may", "could", "should", "would", "might" or "will" be taken, occur or be achieved. Forward-looking statements involve known and unknown risks, uncertainties and other factors which may cause the actual results, performance or achievements of Teck to be materially different from any future results, performance or achievements expressed or implied by the forward-looking statements. These forward-looking statements include statements relating to our technology and innovation strategy and potential benefits, the potential savings associated with autonomous haul trucks, the value potential of smart shovels and statement that smart shovels have the potential to add several hundred million dollars of free cash flow at HVC and the value potential of artificial intelligence at our operations.

These forward-looking statements involve numerous assumptions, risks and uncertainties and actual results may vary materially. These statements are based on a number of assumptions, including, but not limited to, assumptions noted in the various slides and oral presentation, and assumptions that the various technology initiatives can be implemented as anticipated successfully at our operations in a timely and cost effective manner. Events or circumstances could cause actual results to differ materially. Factors that may cause actual results to vary include, but are not limited to actual performance of various technology initiatives at our operations.

We assume no obligation to update forward-looking statements except as required under securities laws. Further information concerning assumptions, risks and uncertainties associated with these forward-looking statements and our business can be found in our most recent Annual Information Form, as well as subsequent filings of our management's discussion and analysis of quarterly results, all filed under our profile on SEDAR (<u>www.sedar.com</u>) and on EDGAR (<u>www.sec.gov</u>). Teck does not assume the obligation to update forward-looking statements except as required under securities laws.

# Teck's Digital Foundation

### Connectivity



- Early adopter integration of digital systems and operating technology began a decade ago
- One Teck approach
  = lowest quartile
  systems costs<sup>1</sup>
- Strong digital foundation across sites

### Data Analysis & Machine Learning



- Site-based Internet of Things creates
   60 GB/day, feeding data lakes
- Machine learning predicts equipment faults before they happen
- Data analysis finds degraded roads and directs maintenance

# Partnerships and Collaboration



- Collaborating with digital leaders including Google, Microsoft and MIT
- Partnering with start-up digital innovators in areas such as Virtual and Augmented Reality

### **Digital Workforce**



- Technologies & tools augment our people
- Standardized platform in mobile equipment across Teck
- Heads up Display (HUD) in shovels will guide operators

# **Our Innovation Focus**



### Productivity

- Equipment automation
- •Ore sorting technology
- •Digitally-enhanced operator performance
- Predictive maintenance
- •Improving grade and processing



### Safety

- Fatigue monitoring systems
- •Collision avoidance monitors
- Remote & autonomous mobile equipment
- •Wearable OH&S systems



### Sustainability

- •Ore sorting to reduce energy use and tailings
- •Water management technologies
- Dust management
- •Digital community engagement



### Growth

- •Exploration tech: Hyperspectral core scanning
- •Growing markets through new product uses
- •Partnering with gamechanging innovators

### **Digital Foundation**



# Teck's Technology Pipeline



# Autonomous Haul Trucks

Potential for improved productivity and safety; deploying in 2018

#### Value potential

- Improved safety
- Highland Valley Copper (HVC): >\$20M annual savings
- Teck-wide: >\$100M annual savings potential
- Potential to steepen pit walls and narrow road widths; reduce environmental footprint

#### **Maturity**

• Proven technology; well understood

- Partnering with Caterpillar
- Site assessment 2017
- Six-truck deployment at HVC by end of 2018
- First autonomous fleet at a deep pit mine



![](_page_5_Picture_15.jpeg)

![](_page_5_Picture_16.jpeg)

# **Smart Shovels**

### Shovel-mounted sensors separate ore from waste

#### Value potential

- Increased grade to mill
- Potential to add significant free cash flow at HVC alone
- Reduced energy use and tailings; improved sustainability performance

#### **Maturity**

• Currently being piloted by Teck

- Pilot launched in 2017
- First ever use of ore sorting technology on a shovel
- Assessing Red Dog deployment in 2018
- Opportunity to replicate and scale up across operations

![](_page_6_Picture_13.jpeg)

![](_page_6_Picture_14.jpeg)

![](_page_6_Picture_15.jpeg)

# **Artificial Intelligence**

### Using AI to predict and prevent maintenance problems

#### Value potential

- Machine learning analyzes data streams from each haul truck to predict maintenance issues before they happen
- Reduce unplanned maintenance, reduce overall maintenance costs, extend equipment life
- Potential \$1.2 million annual savings at just one site

#### **Maturity**

- Successfully developed at Teck coal site
- Partnership with Google and Pythian to develop analytic algorithm

- Successfully implemented in production
- Wider deployment underway at coal sites in 2018

![](_page_7_Picture_12.jpeg)

![](_page_7_Picture_13.jpeg)

![](_page_7_Picture_14.jpeg)

# **Operator Augmentation**

Heads-up Displays empower shovel operators to increase efficiency

#### Value potential

- Augment shovel operators with operational data to achieve higher levels of efficiency
- Reduce shovel non-productive hours and improve overall productivity and safety
- Potential >\$5M annual savings at just one site

#### **Maturity**

• Currently being piloted by Teck

- Development launched in January 2018
- First prototype in the mining industry

![](_page_8_Picture_11.jpeg)

![](_page_8_Picture_12.jpeg)

![](_page_8_Picture_13.jpeg)

![](_page_8_Picture_14.jpeg)

# Notes

Slide 3: Teck's Digital Foundation 1. Based on Gartner benchmarks.

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![](_page_10_Picture_4.jpeg)