REAL-TIME MINING: SENSOR BASED CONTINUOUS PROCESS CONTROL AND OPTIMIZATION IN MINERAL RESOURCE EXTRACTION

AACHEN INTERNATIONAL MINING SYMPOSIA (AIMS 2016)
MINING IN EUROPE
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ON BEHALF OF THE REAL-TIME MINING CONSORTIUM

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EU FUNDED H 2020 PROJECT: PARTNERS

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BACKGROUND: THE POTENTIAL

Potential of critical raw materials in Europe classified by deposit sizes (PROMINE)

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BACKGROUND: BARRIERS TO REALISING THE POTENTIAL

The main barriers to overcome for the successful economic exploitation:

- **effective grade control**, which will maximize resource potential along the whole value chain

- **minimization of handling zero-value material** introduced by dilution, thus reducing unnecessary expenditure of energy and financial resources and

- **management and control of the geological uncertainty** due to limited information available.
Main Source of Risk: Geological Uncertainty

Limited Information 1:10,000,000

Complex Geology

Tight product specifications
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NEW INFORMATION POTENTIAL

Increasing Availability of Sensor Based Online Data:
• Material characterization (geo-chemical, textural and physical properties)
• Equipment performance, upstream and downstream (e.g. efficiency, down-time)
• Equipment location (e.g. GPS, UPS)
THE REAL-TIME MINING APPROACH (H2020 PROJECT)

Discontinuous and Intermittent Process Monitoring and Decision Making

INNOVATION

Near-Continuous Process Control and Optimization

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Overall objective: Develop an innovative technical solution for resource-efficient and optimal high precision/selective mining in geologically complex settings using online data.

Hypothesis: recovery can be significantly increased by changing mineral resource management from a ‘batch-type’ to a near-continuous model-based controlled activity

EU Approval: Project Started: April 2015   Completion: March 2019
REAL-TIME MINING: THE BUILDING BLOCKS

**BB 1: Sustainability and Industrial Viability Indicators**
Evaluation towards resource efficiency and environmental impact
Economic measures accounting for sustainability and industrial viability

**Mining Machine**

- **BB 2: Underground Positioning**
  - Positioning and inertial navigation
  - Infrastructure

- **BB 3: Sensors for Material Characterization**
  - Sensors - combinations
  - Link to ore properties (geochem, texture, mineralogical physical)
  - Representative sampling strategies

- **BB 4: Sensors for Machine Performance**
  - Machine performance measures such as cutting energy and link to material properties

**Exploration and Mine Planning**

- **BB 5: Data Integration, Management and Visualisation**

- **BB 6: Sequential Resource Model Update – Real Time**
  - Real-Time updating integration of exploration data and sensor information (material + machine performance sensors)

- **BB 7: Integrated Long- and Short-Term Optimization**
  - Rapid optimization of short-term sequencing and production control
  - Integrated optimization of short- and long-term planning

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EXTRACTION METHODS: RTM CYCLIC EXTRACTION

Step 2: Ore Handling

Drill Hole

Core Sample

Ore zone

Selective Loading Scheduling

Ore-pass

Muck-pile

LHD

Ore Transfer

BIN

Crusher

Control decision points

Sensors for material characterization

Sensors for machine performance

Sensors for geo-referencing (positioning and material tracking)

Selective Loading Scheduling

Dispatching

BIN A B C

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REAL-TIME MINING: REAL-TIME DATA

Location

Material Characterisation

(Lead: RWTH Aachen)

(Lead: TU Delft)

Machinery

(Lead: Sonic SampDrill)
TEST CASE 1

“Reiche Zeche” Research Mine
Freiberg, Germany

Source: Description „Test Site Mine „Reiche Zeche‘, Freiberg, Saxony, Germany“ provided by TU Bergakademie Freiberg

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TEST CASE 2

“Neves Corvo” Copper Mine
Portugal (Massive sulphide ore and associated stockwork zone)

Source: lundin mining
THREE TAKEAWAYS

1. Real-Time Mining is an exciting European Union funded H2020 project and integrates multiple disciplines.

2. Making best use of online production information can lead to a shift in paradigm from a batch-type to a continuous process monitoring and control and can create significant value.

3. Real-Time Mining will demonstrate this hypothesis in full industrial scale case studies (TRL 7).
Thank you for your attention and Glückauf

www.realtime-mining.eu