WIPRO
Applying Thought

Application of Big Data Solution to Mining Analytics

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Introduction

Big Data Analytics is now a big blip on the radar of the Mining industry. In a recent survey that included 10 of the Top 20 global mining companies, the Mining Journal said that Big Data Analytics would spur the next wave of efficiency gains in ore extraction, analysis, transportation and processing by enabling faster and better informed decisions at all levels.

In a competitive market, every effort to improve margins using operational intelligence is necessary. That is why analytics is expected to play a major role in driving better asset utilization, boost productivity, and address material flow delays.

Helping achieve this goal are sensors embedded across mining operations. These sensors are generating vast amounts of geoscientific, asset condition and operational data in real time. Improvements in Wi-Fi and 3G/ 4G-LTE speeds are enabling real-time collection of data from the extraction point right up to the final transportation of ore to plants. This data can be analyzed using massively parallel processing and faster distribution of intelligence to stakeholders.

It is possible to do this because modern Big Data platforms can assimilate vast amounts of heterogeneous, real-time inputs from multiple sources. These, in turn, extract real-time predictive and prescriptive analytics to drive operational excellence.

Big Data & Analytics Across Mining Functions

Data sources in the Mining industry may be classified as either direct or indirect (ancillary) measurements. Direct measurement sources are those taken by instruments such as conventional geodetic surveys and GPS. Indirect sources refer to systems that collect data as a by-product of processes or operations such as Fleet Management Systems, SCADA or DCS data, blast hole drills and geo modeling data.

To improve ore recovery, an ore body modeling technique is used. The model provides geological patterns that determine drill holes. The key to taking the right mining decisions is, therefore, the availability of accurate data from multiple systems combined with real-time (or near real-time) analytics (see Figure 1). These decisions can be applied to mining exploration, production and operations. They can also be used to monitor and report metrics and KPIs. Additionally, they serve to identify root causes for operational bottlenecks such as unscheduled truck maintenance delays, long queuing time of trucks and LHDs, delays in lab samples undergoing quality control and batch processing etc.

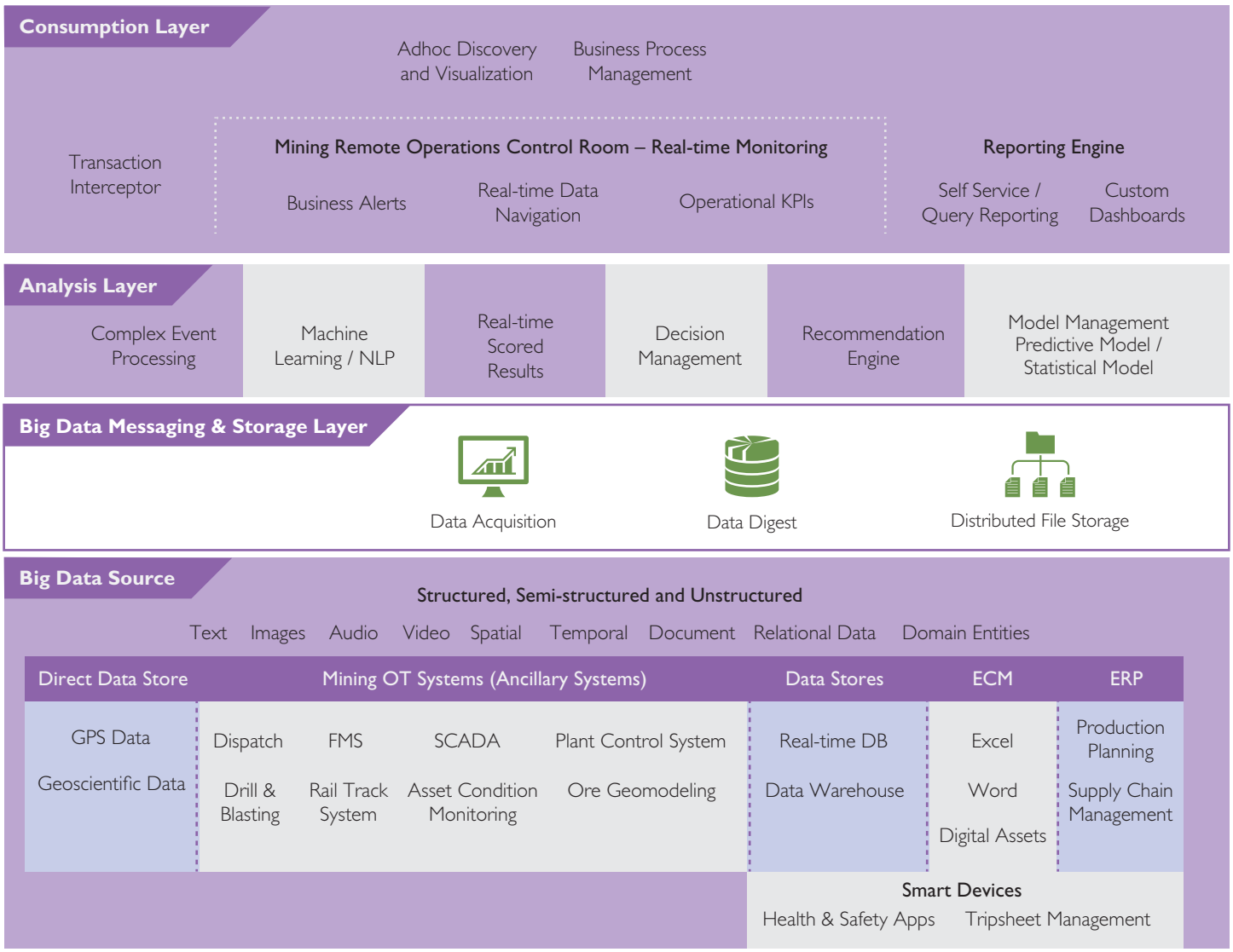
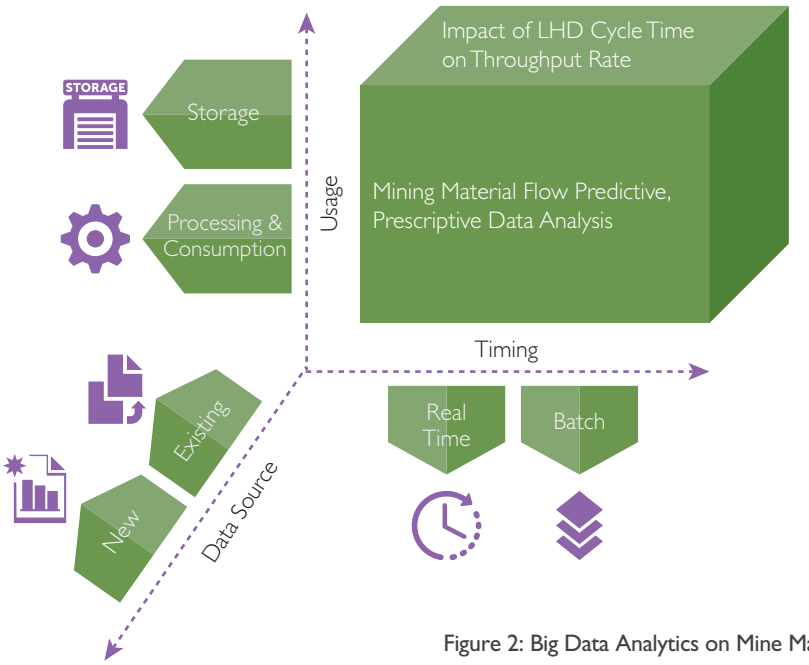


Figure 1: Big Data Analytics Solution Framework

Aside from providing insights for decision-making, the Big Data Analytics Platform can also provide prescriptive solutions around decisions (for an example see Figure 2).



Correlating the causal variable patterns such as loading time, hauling time, dumping time, idle time and queuing time on the overall Average Cycle Time over a period which would impact the Throughput Rate.

Apply historical as well as real-time data analytics to determine patterns which can help in predicting production throughput.

Figure 2: Big Data Analytics on Mine Material Flow

Interventions Across Mining Processes

Material process flow plays a big role in the mining value chain. This includes analyzing impact of unscheduled events owing to mechanical breakdowns of LHDs, trucks and critical transportation medium, queuing time, and such overheads. There are a number of other causal variables that can be analyzed for impact on production throughput on a daily/monthly basis using techniques such as Machine Learning, Continuous Pattern Matching and Statistical Predictive Model.

Big Data Analytics Platform, equipped with these models, can leverage the value, volume, velocity and variability of data, delivering several benefits across extraction, intermediate transportation and final transport to plants. Figure 3 shows the causal data used at each process step to improve operational effectiveness and enable higher ore yields.

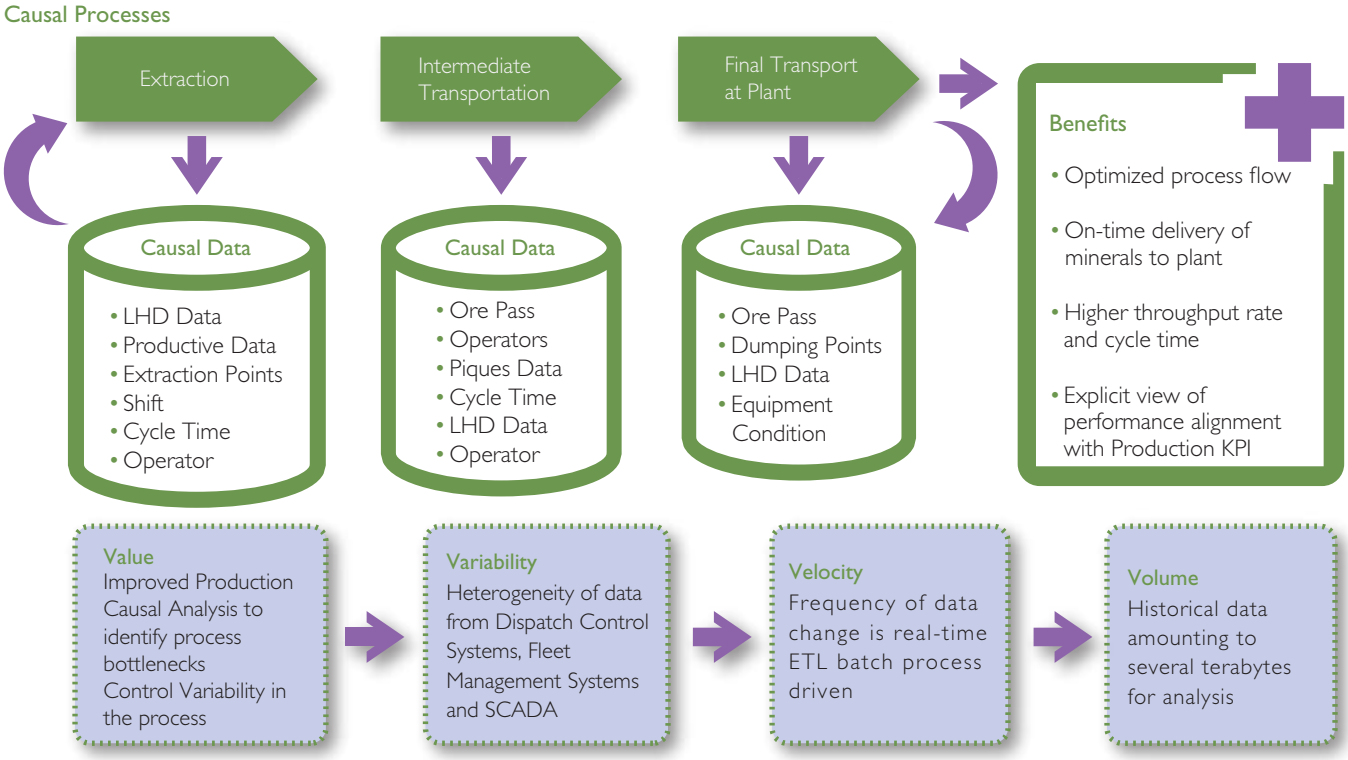


Figure 3: Causal and Correlation Analysis using Big Data

Some use cases where Big Data Analytics Platform can come in handy are:

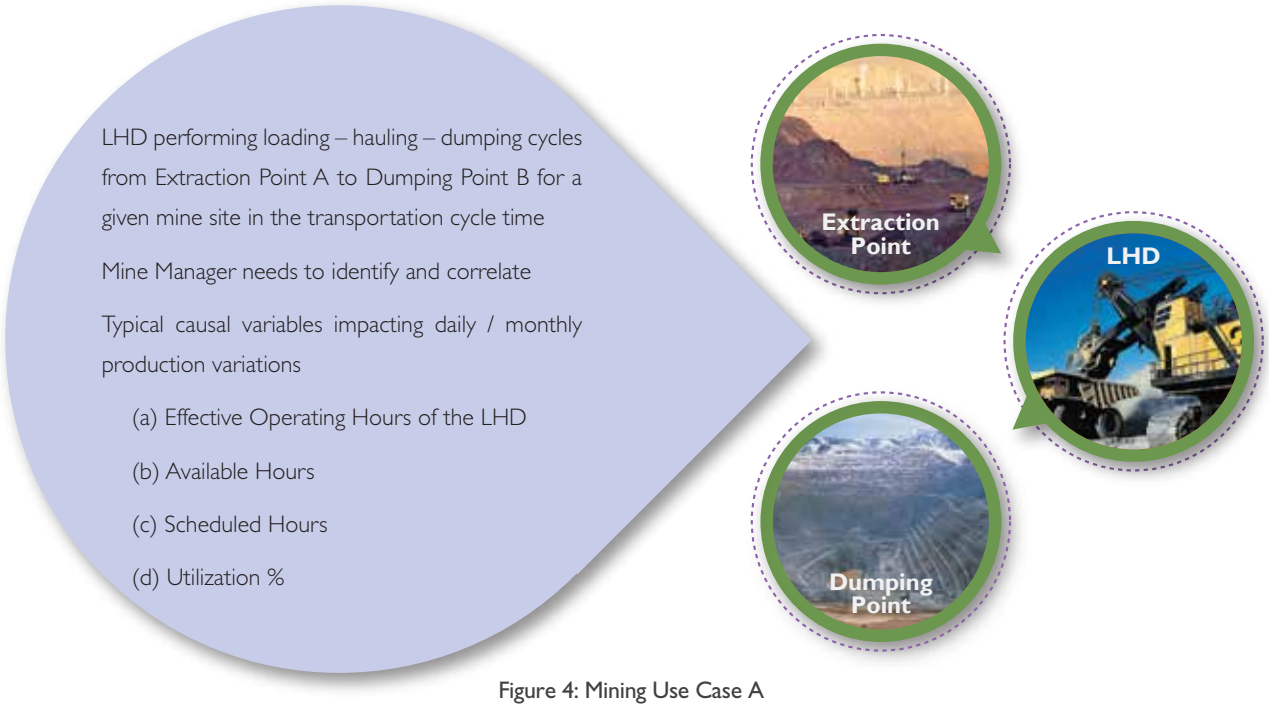


Figure 4: Mining Use Case A

Figure 5: Mining Use Case B

LHD performing loading – hauling – dumping cycles from Extraction for a given mine site in the transportation cycle

Mine Manager needs to identify and correlate the following Haul Truck Performance Variables behind the Daily / Monthly Production variances

(a) Tons Moved
(b) Throughput Rate
(c) Operating Hours
(d) Average Load Cycle
(e) Total Cycle Time
(f) Average Cycle Time

Cost of unplanned and mechanical outages of Trucks is a big expense on mining companies. Typical parameters that drive the maintenance cost are as follows to name a few of the variables

(a) Engine Oil Pressure
(b) Engine Oil Temperature
(c) Hydraulics Oil Temperature
(d) Transmission Oil Pressure
(e) Transmission Oil Temperature
(f) Coolant Temperature
(g) Break Changing Pressure

Using Big Data Analytics platform it is possible to identify machine patterns and predictive models to do proactive maintenance of Trucks.

Figure 6: Mining Use Case C

The mobile drill rigs of the future resembles a mobile surveying and sampling laboratory which can collect, analyze and access huge volumes of complex geochemical and geophysical data. The data can be synced with the central server for validation. QA/ QC routines built into data collection mechanism ensure data quality problems are identified at the source. The adoption of Big Data platform ensures complex and near real-time geochemical/ geophysical data is able to be processed and analyzed. The interpreted results from analysis is communicated near real-time to survey geologists.

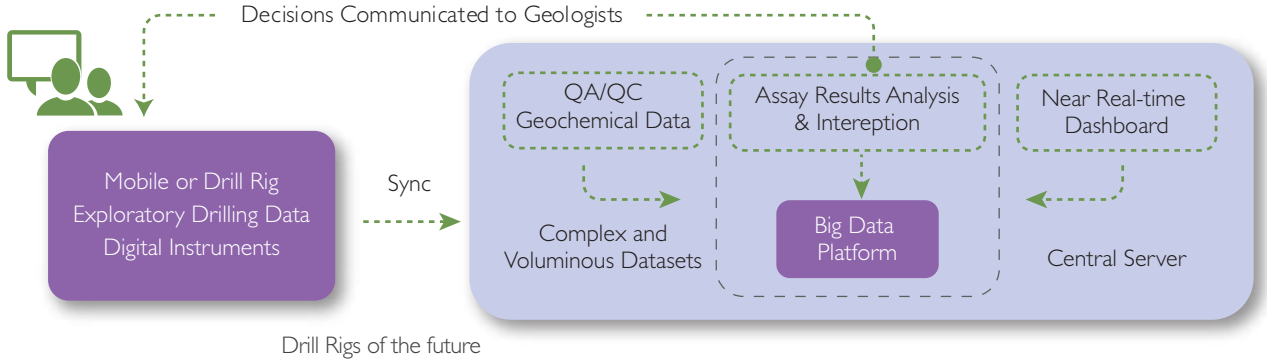


Figure 7: Mining Use Case D

Where Lies the Value

The Mining industry can derive several critical business benefits from Big Data Analytics. These include:

- Ensuring continuous flow of material from ore extraction point to the processing plant
- Maximizing ores hauled by optimizing bottlenecks in production
- Reducing non-productive time between unit operations such as unscheduled maintenance, delays, wastage and waiting time
- Helping management make informed decisions on the "as-is" production process, covering the value chain from extraction to delivery at plants and beyond
- Providing on-the-fly assay results and interpretation analysis to field geoscientists to take informed decisions

For organizations considering such a platform, ensuring a low Total Cost of Ownership without vendor lock-in, with the ability to scale horizontally should be major considerations.

About the Author

Sandipan Chakraborti is working as a Senior Architect in Wipro's Energy, Natural Resources & Utilities business. His work involves architecting presales solutions, realizing architectures through projects and engaging with customers for proof of concepts. Sandipan has over 16 years of experience in areas of consulting, presales and delivery. Prior to working with Wipro, he was a Principal Consultant in the strategy and architecture unit of a leading global consulting organization. He can be reached at sandipan.chakraborti@wipro.com.

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