

NATURAL RESOURCES

# LEVERAGING THE INDUSTRIAL INTERNET AND INDUSTRY 4.0

Employing a business platform for operational excellence in mining



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## INTRODUCTION

Mining is not a single process but a sequence of processes managed across the supply chain, from geology studies to commodity shipment. This paper proposes a way to improve the efficiency of mining production by enhancing the interaction of its different processes by employing a **Business Platform** that bridges the gap between Information Technology (IT) and Operational Technologies, and draws upon the Industrial Internet (which for the purposes of this paper includes the Internet of Things). By doing so, we posit that greater efficiency can be achieved, along with waste and cost reduction. Ultimately, the merging of these worlds, through such a platform, will provide management with higher confidence in operational performance as critical decisions are made using real-time data.

- Information Technology is the application of computers to store, retrieve, transmit and manipulate data.<sup>1</sup>
- Operational Technology is hardware and software that detects or causes a change through the direct monitoring and/or control of physical devices, processes and events in the enterprise.<sup>2</sup>
- Industrial Internet of Things Technologies (IIoT) is automation and data exchange in manufacturing technologies. It includes cyber-physical systems, the Internet of Things and cloud computing.<sup>3</sup>
- The Internet of Things (IoT) is the network of physical devices, vehicles, buildings and other items—embedded with electronics, software, sensors, actuators and network connectivity— that enable these objects to collect and exchange data.<sup>4</sup>



## MOST MINES ARE OPERATING IN THE DARK

The various processes of mining have their own autonomy, but also have influence on each other as they are part of a chain of tasks. Even if each process runs perfectly, it usually runs in a silo, without its operators knowing how well the overall chain of processes is performing. Upstream processes may not be in sync with those that follow downstream.

The existing methods of creating a holistic view of a mining operation usually result in a view of what happened too far in the past to be of real value in the present. Too often this view is constructed at too infrequent intervals. Often, late updating of this view occurs because of the time involved to gather data, compile it, and the limitations of the systems used to do so (spreadsheets, for example). As an example, blasting at a mine site may continue to occur even after a new survey has concluded that what was thought to be high grade area is not.

Ultimately, the root of the problem is that IT and OT systems do not provide the data required by decision-makers. To do so, an enabling platform must be employed that collects data from across the operation, delivering it where and when it is needed, in the right context for different mining roles.

### The integration gap – the reality of the productivity issue:

Many “productivity” initiatives to date have focused on cost cutting, which have led to some modest, short-term results, but our survey participants acknowledged that what needs to be done now is more complex. Our view is that mining companies should move beyond point solutions, and adopt an end-to-end solution to transform the business. There is a need to ensure that each part of the business is optimized, not on its own, but as part of a business system. A number of the executives interviewed highlighted “the integration gap” and their desire to close it. Addressing integration is a key challenge for improving productivity, and requires an approach that breaks down the silos and adopts an end-to-end perspective.

Source: (Ernst & Young Productivity in mining: now comes the hard part - A global survey)

## SHEDDING LIGHT ON OPERATIONS

CAPABILITY	ENABLING TECHNOLOGY
Integration, centralization, analysis and presentation of all operational data	<b>Business Platform</b> Delivery of global visibility, including dashboards, in near real time to all stakeholders, according to their responsibilities
Real-time monitoring and reporting	<b>Industrial Internet Technologies</b> Gathering of data from sensors, which is fed into the Business Platform
Interpretation of information in a rapid, usually automated, manner	<b>Big Data Predictive Analytics</b> The processing of large amounts of granular data in order to deliver relevant and understandable business indicators

Industrial Internet technologies have already provided benefits in the manufacturing industry (applied through what is widely called “Industry 4.0”). These systems have delivered automated consolidation of data to enable near real-time management.

Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies. Industry 4.0 creates what has been called a “smart factory”. Within the modular structured smart factories, cyber-physical systems monitor physical processes, create a virtual copy of the physical

world and make decentralized decisions. Over the Internet of Things, cyber-physical systems communicate and cooperate with each other and with humans in real time; both internal and cross-organizational services are offered and used by participants of the value chain.<sup>5</sup>

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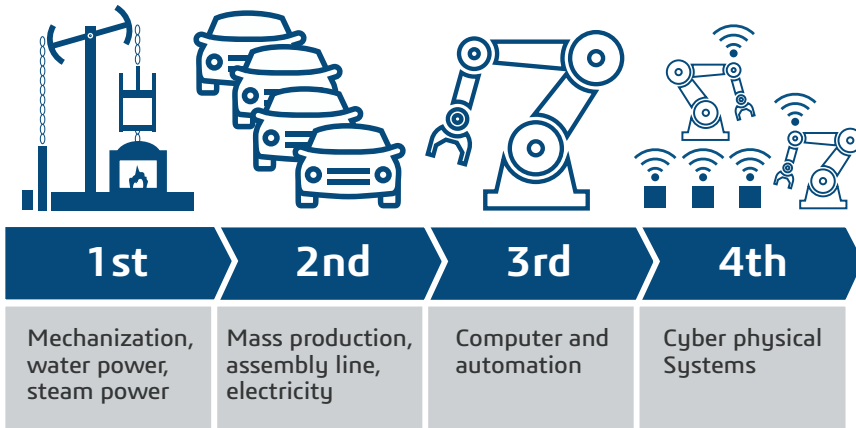


Figure 1: 4 Industrial Revolutions from 19<sup>th</sup> to 21<sup>st</sup> Centuries  
By “Christoph Roser at AllAboutLean.com.” - Own work“

The World Economic Forum’s 2015 report entitled Industrial Internet of Things: Unleashing the Potential of Connected Products and Services states, “With the Industrial Internet, manufacturers are already using new software capabilities to improve operational efficiency through predictive maintenance, and achieving results, such as savings on scheduled repairs (12 percent), reduced maintenance costs (nearly 30 percent) and fewer than 14 Industrial Internet of Things breakdowns (almost 70 percent).”<sup>6</sup>

Their research found that key business opportunities will be found in four major areas:

1. Vastly improved operational efficiency (e.g., improved uptime, asset utilization) through predictive maintenance and remote management.
2. The emergence of an outcome economy, fuelled by software-driven services; innovations in hardware; and the increased visibility into products, processes, customers and partners
3. New connected ecosystems, coalescing around software platforms that blur traditional industry boundaries.
4. Collaboration between humans and machines, which will result in unprecedented levels of productivity and more engaging work experiences.

While some of these areas may appear to be applicable to Business-to-Consumer (B2C) businesses at first glance, after considering them more deeply, one can see that they can better inform supply chain management and customer engagements for Business-to-Business (B2B) companies. Phase 1 and Phase 4 are most directly applicable in mining, both in terms of what is being achieved today (Phase 1) and what is being talked about as the future of mining (Phase 4). However, while we do not explore them in this paper, we expect to see elements of Phase 2 and Phase 3 emerge in B2B natural resources industries.

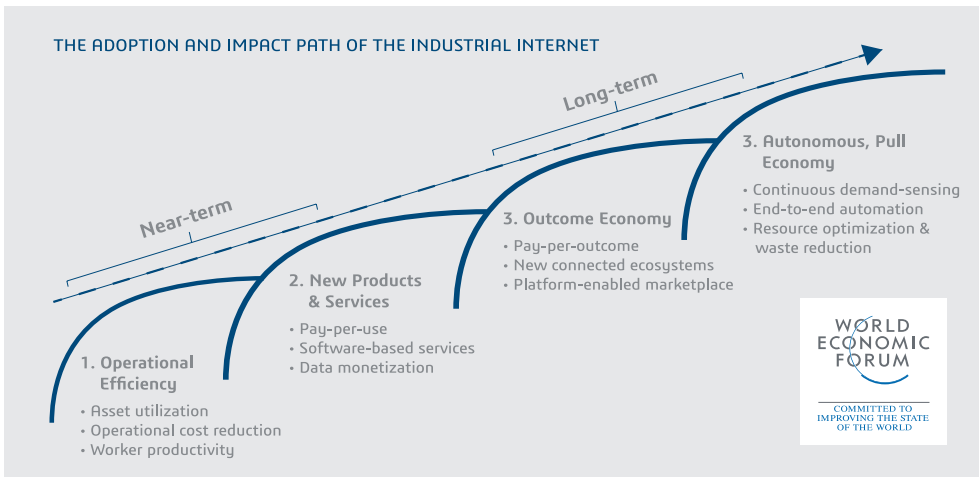


Figure 2: The 4 Phases of the Industrial Internet

Optimization and innovation in business are continuous, but are challenging when external factors such as low and variable commodity prices play a role. This is because production must scale up and down with demand.

This challenge is further compounded because many commodities have reached a point of decreasing grades globally, which increases operating costs.

With fewer high grade deposits available to help weather more fickle pricing and demand, mining costs have to be reduced to increase profit margins, or avoid losses.

### INDUSTRIAL INTERNET OF THINGS

The foundation of manufacturing's Industry 4.0 comes from the Internet of Things (IoT). IoT connects devices and equipment to the internet, allowing interaction with them to occur in new ways. Today, in mining, this may be automation of a truck or a shovel. Tomorrow, it may lead to development of a virtual clone of a mining operation that sends automatic updates of schedules and tasks based on production progress.

The first phase of the Industrial Internet of Things (IIoT), which occurs before the automation of equipment, makes improvements to operational performance possible by breaking down the silos between processes. It taps into key operational data from sensors and other sources.

This makes possible the creation of a holistic, real-time view of what is happening across the operation, and the promise of faster response time to problems.

### BUSINESS PLATFORMS ENABLE OPERATIONAL STABILITY

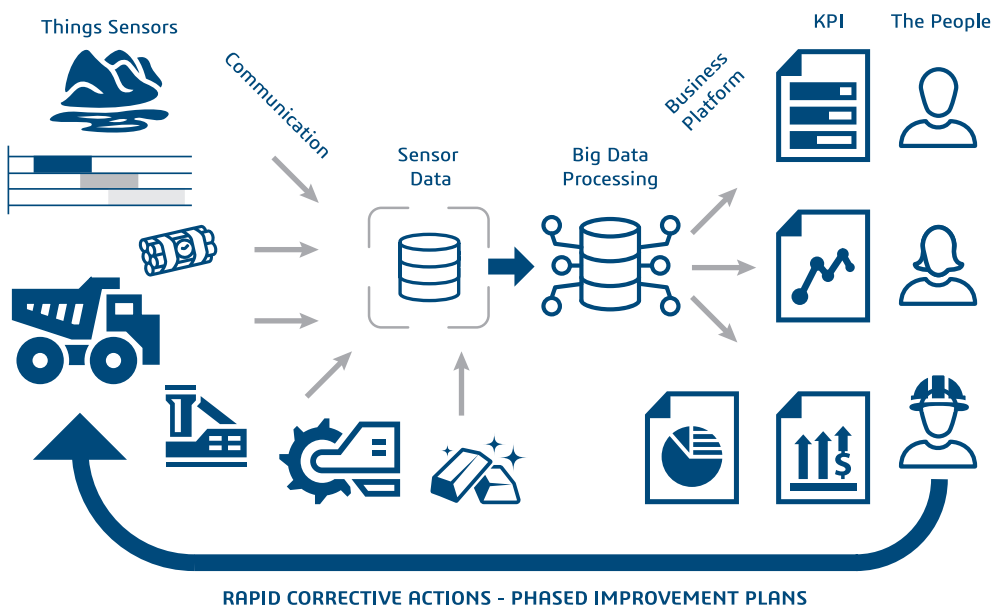


Figure 3: The Industrial Internet of Things

When mining processes operate in silos, a disruption in one process may lead to disruption of both the previous process and the following one. For example, an inaccurate blasting process can lead to blockages caused by rocks that may be too large, which in turn could more rapidly damage shovels and trucks or delay the hauling process.

The availability of real-time operational data from every process helps facilitate operational stability. This removes silos between processes, improving the understanding of the impact each one has on the other and also improving the detection of problems.

The overall visibility provided by a Business Platform enables reconciliation and reporting through all areas of mining. When a process shows variation, a second benefit is that the mine manager will also be able to more rapidly adapt the other processes. Thus, the cascading effects of an issue are avoided.

A Business Platform connects disparate types of data from Information, Industrial and Operational Technologies. Essentially, it centralizes these systems into one platform. It connects data from geological models, mine schedules, activities and equipment to form a clear picture of how well the mine is functioning. Further, since it has granular information, it can easily identify areas of variation and allow for a thorough investigation into the root cause. The key objective it supports is keeping production on track against plan by accounting for forecasts, actuals and variance.

To keep mining staff informed of what is most important to them, Business Platforms produce reports according to the needs of each person and role within the mine. Such systems also deliver notifications to staff if there is a difference between forecast and actual, as well as variance to specification limits.

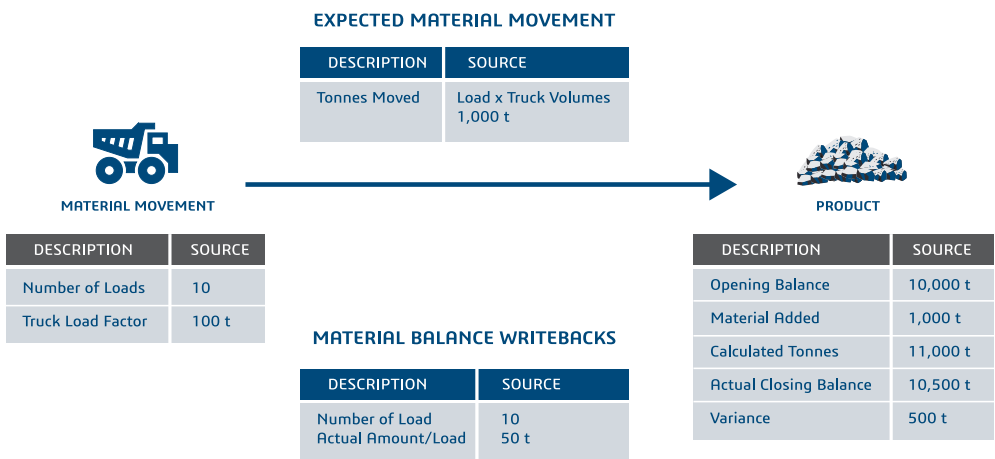


Figure 4: Production Reconciliation

#### Customer case study:

Dundee Precious Metals is seen as a pioneer in IoT deployment. It achieved significant productivity and cost control gains at its Chelopech mine in Bulgaria. With access to Wi-Fi underground and using advances like real-time monitoring and site-wide production reporting, the site doubled production and reduced costs per ton by 44 percent. A Dassault Systèmes' GEOVIA® brand solution called GEOVIA InSite™ is used as an integrated production management solution for shift reporting and analysis. It also acts as the central monitoring and control system for the mine and provides metals balancing.

Source: (MaRS Market Insights: Mining & Metals + Internet of Things: Industry opportunities and innovation- November 2014)

## RAPID RESPONSE

When decision managers lack real-time visibility on how their businesses are running, managing the inherent variability in them is challenging. Getting a status once a week (or even once a day) cannot address inefficiency because the information is out of date. And, without the systems in place to rapidly identify and communicate necessary adjustments, recovery tasks can take too long to plan and implement.

This is the role of **Big Data Processing**. Transforming the massive amount of data collected by IoT and turning it into understandable indicators is achieved via Predictive Analytics software.

Deviations should be identifiable when they happen, not after-the-fact. A Business Platform can deliver the required Key Performance Indicators (KPI's) by thorough Big Data Processing. With a Business Platform, Short Interval Control can be realized, which is the rapid response to deviating performance.

## SHORT INTERVAL CONTROL

Short Interval Control refers to a controlled system of planning an operation's activities in fixed time intervals throughout a shift (LeanProduction.com, 2013). It is the execution of a process that engages managers and/or team members to review performance data regularly within their shift to assess where they need to focus their efforts to improve performance. A shift would usually be divided in two intervals.<sup>7</sup>

**Business Platforms** deliver a powerful yet easy way of collecting project and task information into one online "big picture" of work, thanks to easy-to-read dashboards, so the staff does not drown in information overload. They also allow for investigations by enabling users to dig down to any level of data granularity from a KPI.<sup>8</sup> A business dashboard should be completely configurable to the needs of each one of its users.

A typical discrepancy between production targets and actual execution in the mining business is seen in Mine Call Factor (the ratio, expressed as a percentage, of the total quantity of recovered and unrecovered mineral product after processing, with the amount in the ore estimated based on sampling).

The cause(s) of an error responsible for a discrepancy can come from so many parameters and mining processes that a deep study is required to make even less-than-timely changes. It would be better, therefore, to "proactively reconcile" through short intervals, and to run "root cause identification". This will enable more rapid solving of unknown reasons for performance decreases of complex processes of a mine and plant.

With a Business Platform, the identification of the value most influential factor for a variance is driven from the analysis of historical and real-time operation data. It facilitates corrective and preventive action. By taking into account the quantified influence of process variables, the solution can provide advanced warning of potential problems, allowing users to adjust their processes in real time.

## BUSINESS PLATFORMS AND CONTINUOUS IMPROVEMENT METHODOLOGIES

A Business Platform can be used to drive continuous improvement programs, such as Six Sigma, which is a data-driven approach that eliminates defects in a process. Six Sigma focuses on define, measure, analyze, improve, and control of processes. It began in 1986 as a statistically-based method to reduce variation in electronic manufacturing processes at Motorola Inc. in the United States of America. Its initial target was to eliminate defects, but it can be used in general to make incremental improvements or larger ones.

## CONCLUSION

A **Business Platform** that draws upon the Industrial Internet connects two worlds that do not traditionally talk to one another enough: Information Technology (IT) and Operational Technology (OT). By doing so, it allows for rapid response to problems and a holistic understanding of how well an operation is performing. With real-time data, deep analytics and simplicity, Business Platforms that bring the two worlds together not only provide their users with an accurate picture of how well processes and the site is performing, but also the knowledge to fundamentally improve them.

### Business Platforms can:

- Enable a near real-time view of the performance of a global site.
- Deliver alerts rapidly on differences between plan and execution, such as the geological grade forecast and the post blasting ore analysis.
- Detect discrepancies of transactions between processes, such as the reported hauled material and the material received by the process plant.
- Unlock Big Data to identify positive and negative influence factors on processes and performance.

## REFERENCES

- <sup>1</sup> Daintith, John, ed. (2009), "IT", A Dictionary of Physics, Oxford University Press
- <sup>2</sup> [https://en.wikipedia.org/wiki/Operational\\_Technology](https://en.wikipedia.org/wiki/Operational_Technology)
- <sup>3</sup> Hermann, Pentek, Otto, 2016: Design Principles for Industry 4.0 Scenarios
- <sup>4</sup> "Internet of Things Global Standards Initiative", ITU, 26 June 2015
- <sup>5</sup> Hermann, Pentek, Otto, 2016: Design Principles for Industry 4.0 Scenarios
- <sup>6</sup> From World Economic Forum – Industrial Internet of Things study – 2015
- <sup>7</sup> Short interval Control in Today's Underground Mine R. Howes (Dundee) C. Forrest (Gemcom) MineExpo 2012
- <sup>8</sup> "Enabling the rise of Enterprise Program management" E-Book from Chad Jackson of Lifecycle Insight

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