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Procedia Engineering 138 (2016) 64 – 71

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**Procedia  
Engineering**

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“SYMPHOS 2015”, 3rd International Symposium on Innovation and Technology in the Phosphate Industry

## Disruptive Innovation in Digital Mining

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### Abstract

Mining companies are shifting their strategies and adopting new business and operating models to include new technologies and are doing so on a more rapid and global basis than ever before. A combination of market volatility, changing global demand, radically different input economics, new locations in search of more reserves, a focus on a longer asset lifecycle and a commitment to operational excellence as well as policy shifts around the globe are all contributing to a seismic shift in the industry.

Decades of cost reduction and the aging workforce have left mining companies with limited resources to adjust. Now, a rapidly evolving set of new technologies – the Digital Transformation – open new possibilities to improve operating efficiency, develop more accurate and agile planning, heighten vendor awareness and collaborate with business partners throughout the value chain.

The mining industry is at the epicenter of this digital transformation, which is very real and can drive considerable differentiation and competitive advantage within the industry. Automation of the mines, new analytic capabilities, digital workers, remote and autonomous operation are just some of the examples where the technologies are disrupting the mining industry today. All of these need to be looked at very closely to drive growth and increase efficiencies.

It is critical for mining companies to understand the digital transformation and its associated opportunities and risks. A more interconnected and information based operation will continue to push the envelope of what needs human interaction. The possibilities for new operating models and new levels of optimization will create the next wave of differentiation in the industry.

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Peer-review under responsibility of the Scientific Committee of SYMPHOS 2015

**Keywords:** Mining industry Digital Transformation; Digital operations; Information Technology environments; Operation Technology organizations; Technology progress and innovation;

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## 1. Looking for the full value of Digital Operations

Discussions around Digital Operations are happening everywhere, including topics such as analytics, cloud, mobility and Internet of Things.

The mining industry is no exception, as executives from mining companies question how to translate the so-called “Digital Transformation” into real positive top and bottom line impact for their organizations.

These discussions gain a special attention in the current business context in the industry, where a combination of market volatility, changing global demand, radically different input economics, new locations in search of more reserves, a focus on a longer asset lifecycle and a commitment to operational excellence, as well as policy shifts around the globe are all contributing to a seismic shift in the industry.

Decades of cost reduction and the aging workforce have left mining companies with limited resources to adjust. Now, a rapidly evolving set of new technologies appears to open new possibilities to improve operating efficiency, develop more accurate and agile planning, heighten vendor awareness and collaborate with business partners throughout the value chain.

However, the expectations around Digital Transformation are also accompanied with plenty of uncertainties on how these technologies can effectively make the difference and how to get there.

More importantly, few are the companies that have been able to present disruptive effects of Digital Transformation in their corporate performance.

Given this context, three questions seem to be fairly presented by the executives and are worth being better explored in this paper. The questions are:

- What is Digital Transformation?
- How can Digital Transformation impact mining companies?
- How can mining companies extract the full value of Digital Transformation?

Below we present our point of view on what would be appropriate answers for each one of these questions.

## 2. The Digital Transformation

Digital Transformation is tightly related to the increased velocity at which more and more information is becoming available to individuals and companies, and how it is allowing for new ways of doing things.

A direct relation can be drawn between digital and the new ways information is being generated and consumed. Internet of Things will increase the amount of information available. Mobility will facilitate its distribution and consumption. Social and Collaboration will intensify knowledge exchange. Analytics will allow more complex decision-making on high volume real-time data. Cloud will enable more agility and scalability for dealing with the inherent variability of processing and storage capacities required by all this information.

This Digital Transformation is already happening in the mining industry, where very complex and sophisticated digital solutions have already been implemented.

### Remote Operation Centers

A good example is the Remote Operate Centers (ROC). ROCs have been utilized for some time in other industries such as Oil & Gas and more seriously in mining companies in the last few years. There are relevant examples of mining companies already controlling several mines, ports and thousands of kilometers of heavy-haul railway from a single remote operation center. Heavily based on network availability and remote operations technology, the remote operation centers are reducing operating costs and reducing risks to people's safety, as fewer people are required to stay on remote and hostile places and, consequently, less supporting infrastructure, such as hospitals, schools, dwellings, among others, are required to be available in those remote places.

Example: One mining company has a single remote operation center controlling approximately 15 mines, 31 pits, 4 ports and 1,600km of heavy-haul railway.

### Autonomous Operations

Autonomous operation is another remarkable example of digital already being utilized in mining. There are mining companies already operating huge heavy equipment, such as heavy-haul off-road trucks, drillers and reclaimers, without the operators.

Safety is again a benefit, as fewer people – the operators – are required to stay in hazardous industrial sites. The major impact, however, can be verified by the decrease of the variability in the production outcomes, which leads to a more consistent and efficient operation.

Example: There are more than 200 autonomous trucks operating on different mining companies.

### **Mobility**

One of the remarkable examples of mobility is related to the utilization of geo-position devices that allow tracking and location of people, equipment and other assets.

Increased levels of security can be achieved as the location of people can be controlled with virtual fences delimiting dangerous places. Control of position of assets and people in relation to scheduled activities also leads to better productivity.

Example: One mining company has already utilized geo-tag devices to control the movements of temporary contractors, equipment and assets within its premises during the execution of a major turnaround in one of its plants.

### **Analytics**

Mining companies are still in their first steps in exploring analytics for improving their decision-making process. However, we can already see cases of companies effectively aggregating part of the operations information available and getting it through sophisticated analysis processes for optimizing productivity.

Example: One company is already utilizing telemetry information sent by trucks on analytical models to predict engine failures.

All the given examples above compose a small sample, and several others could be explored as a way to demonstrate that the journey through the digital transformation has already started for mining.

The foreseen future for digital in mining is even more promising.

**Digital Worker:** The digital worker powered by wearable devices and augmented reality will provide incredible gains in asset maintenance activities, drastically reducing the down time of critical assets in the production line.

**Analytics:** As mentioned above, analytics is just in its inception in mining. Real time analytics will allow continuous and rapid adjustment in the production processes, providing step-changes in the levels of productivity.

**Drones:** Inspection of belt conveyors or aerial power lines covering thousands of kilometers will be possible in much shorter periods of time and with greater effectiveness due to the combination of UAVs (Unmanned Aerial Vehicles) with special cameras.

**Intelligent Sensors:** Sensors will become more and more powerful and intelligent. One good example is the utilization of cameras with video analytics. The ability of processing a real time flow of images already allows for a myriad of controls ranging from the detection of anomalies (e.g. fire, pollution, residuals in railcars, heat areas in power lines) to sophisticated methods of counting, tracking and identifying people and objects.

The list can go much further, but we can already see that Digital Transformation can have a profound impact in the way mining companies operate.

## *2.1. The Digital Mining Survey*

The presence of Digital Transformation in the mining agenda can also be verified by the level of attention given to this topic by the key executives within companies in this industry.

An Accenture Digital Mining Survey<sup>[1]</sup> carried out in 2014 with C-Level executives (CEOs, COOs, CIOs and CFOs) from 151 mining companies from around the world revealed that:

- 85% of the executives informed that their companies are aggressively setting and supporting the Digital agenda.
- 88% of the executives informed that their companies are already utilizing digital programs to identify growth opportunities.
- 90% of the executives informed that their companies have digital programs already being expanded into strategy and high-level decision-making

We may consider the possibility that the responses of the executives are somehow optimistic or overrated. However, we cannot ignore that their responses consistently point to the fact that the discussion and expectations on digital are on the top of their minds and will consequently take a significant share of their companies' investments in the following years.

The examples presented above and the results of the Accenture Digital Mining Survey clearly depicts how Digital Transformation is evolving into reality in mining and the potential it has to transform operations in the companies within this industry, what brings us to the next question we want to answer. How much is the Digital Transformation worth for our companies?

### 3. The Value of Digital Transformation

The intrinsic value of Digital Transformation comes from the way it enables companies to do things differently than they are used to doing. Just from the examples already presented above, we can derive:

- Effective use of the rapidly increasing amount of data for real-time and insight-based decision-making and continuous optimization.
- Unprecedented possibilities of autonomous operation, remote control of assets, and tracking of equipment and people.
- Increased collaboration and knowledge sharing among operations teams within and beyond the organization.
- Much more flexible and responsive delivery of solutions to new business demands.

This new way of doing things can, in turn, produce effective impacts on several processes areas, such as:

- Predicted & Condition Based Asset Management;
- Optimized Fleet Management;
- Reduced Operations Variability;
- Systems Performance Management;
- Environment & Safety Controls;
- Integrated Turnaround Management.

And bring concrete business value outcomes:

- Higher throughput and productivity;
- Improved quality of outcomes;
- Lower operating costs;
- Improved human safety;
- Reduced environment risks;
- Improved working capital.

#### 3.1. Digital in the Annual Reports

Looking for the confirmation of such impacts in mining companies overall performance, we analyzed the last annual financial or strategic reports<sup>[2]</sup> issued by the 10 of the biggest global mining companies on market value.

We looked for indications made by these companies on their view of the importance and the impacts digital is producing in their performance.

While 6 out of the 10 companies have explicit mentions to Digital Transformation as part of their strategic intent for improving performance, only 3 of them actually reported qualitative benefits already verified by the application of digital technologies as part of their operations.

More importantly, only 1 out of the 10, reported quantitative benefits verified by the application of digital technologies.

These figures basically tells us that despite everything that has already been done of Digital Transformation in the industry, it hasn't yet reached its full potential, where acknowledging its impact will be worth presenting in companies annual reports.

#### 3.2. Digital Effects in the Mining Industry Productivity

In additional to the analysis just described, Accenture conducted an internal study<sup>[3]</sup> on how the productivity of the mining companies from Brazil and Australia evolved from 1993 to 2013.

The study not only presents how the overall productivity evolved in the industry in these two countries, but also presents the factors responsible for the variations in the productivity:

- TEC: Catch up to better existing technologies.
- TP: Technology progress and innovation
- Depletion: effect in productivity of more scarce and difficult to extract resources.

Although not exclusively related with digital initiatives, the evolution of TP contribution in productivity was used

in this study to assess the potential impact of digital in the overall productivity in the industry.

The charts below present the Components of Brazilian and Australian mining MFP (MultiFactor Productivity index) depletion adjusted.

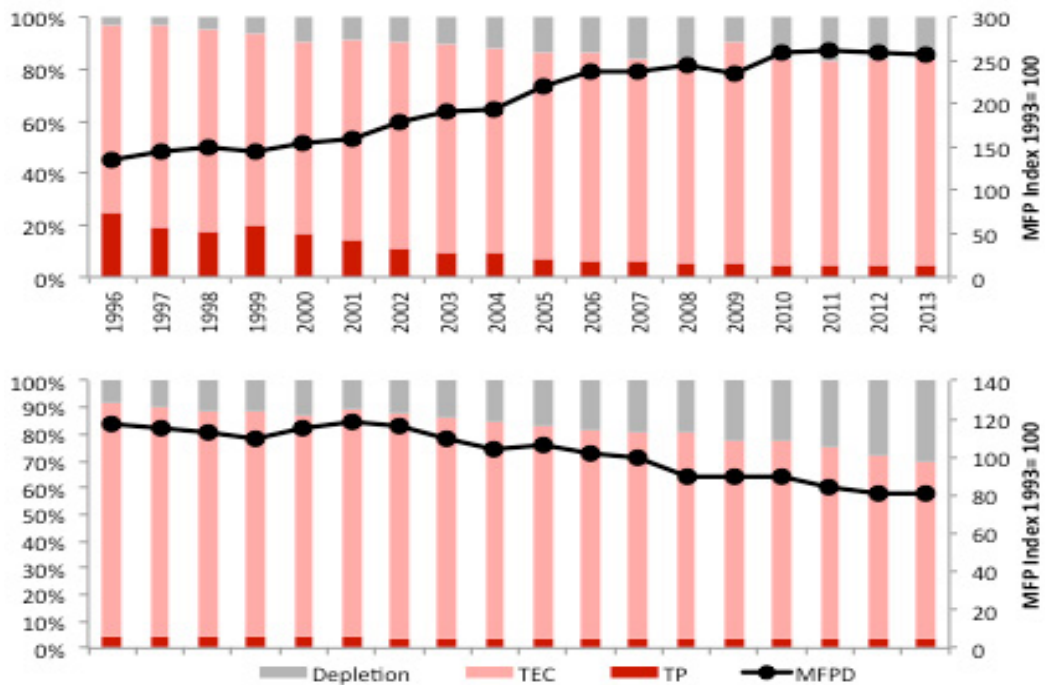


Fig.1 : Figures on the right side indicates the annual Multifactor productivity verified in the two countries considering the MFP Index 1993 = 100.

Percentage on the left side indicates the level of contribution of each component in the final multifactor productivity.

Source: AR EVM CoE, based on Oxford Economics, IBGE (Brazilian Institute of Geography and Statistics) and own calculations. © Copyright Oxford Economics Ltd.

Based on this analysis, it was possible to verify that:

- Mining industry productivity has either declined (Australia) or stayed constant (Brazil) in the past 4 years
- Marginal improvements in operations efficiency (those that come from catching up to better existing technology) are responsible for more than 80% of productivity gains
- Step-change gains in operations excellence (those that come from technological progress and innovation) are almost irrelevant to explain historical growth in productivity

The study also shows that the last time Technology progress and innovation made a real difference in the overall gains of productivity in Brazil was in the end of the 1990s.

It is also important to emphasize that at least in Brazil and Australia, two of the major players in the global mining arena, productivity increase has been a real challenge, what increases dramatically the importance of having something new that can make it happen.

### 3.3. What is wrong?

These results are consistent with the analysis of companies' annual reports in the conclusion that innovation is not yet making it part in significantly improving mining companies overall productivity.

Although these conclusions apply to the majority of the companies in the industries, it is possible to identify some of the mining companies that seem to be a step ahead in exploring the benefits of digital and bringing it to a corporate scale.

Seeking to understand what these companies are doing differently from the others, Accenture initiated an analysis on how companies from both groups have been dealing with Digital Transformation.

The conclusions of this analysis give us a very good perspective of the ways of getting the full value of Digital Transformation.

#### 4. How to Extract the Full Value of Digital Transformation

A starting point for understanding the way mining companies are dealing with Digital Transformation is to clear understand who and how within these organizations are driving this process from a technology point of view.

It is clear that the implementation of digital solutions requires an appropriate technology environment and a prepared technology organization to implement and maintain such solutions.

Both, the technology environment and organization within industrial companies have been strongly challenged by the new demands posed by Digital Transformation.

Among these challenges, three elements seem to be the cornerstones that companies need to address in order to turn digital intent into results:

**Integration:** digital is all about being able to capture the value of the increasing amount of information coming from operations and that will only happen if the information can easily flow through different systems, sites, operations and business units.

**Multi-paced:** with digital comes a new way of developing solutions. A way where innovation and agile development allow quick experimentation and learning, while accelerating results and the identification of possible paths to fail. This new approach doesn't replace the old one, in which the development of foundational or corporate solutions used to take longer development cycles. Instead, both approaches will coexist and technology organizations will have to learn to deal with these multi-paced deliveries

**Resilience:** the technology environments that currently support operations are becoming more and more integrated with the IT environments and with the new frontiers defined by the utilization of cloud and mobile solutions. This integration brings an exposition to security threats that operation teams are not used to deal with. Companies will not be able to consistently grow in the utilization of digital solutions without providing satisfactory answers to the security challenges that come along with these solutions.

In addition to the elements of integration, multi-paced and resilience, it is also important to acknowledge that mining companies in general depends today of multiple technology environments and organizations supporting different business needs almost independently from each other.

One of these multiple organizations is the Information Technology (IT) group, which has been already running most of the corporate systems and infrastructure and is getting more and more close to what happens in the operations side of the business.

There are also the multiple Operations Technology (OT) organizations installed within different business units, operations and sites, and that are responsible for the automation and operational systems (e.g. supervisory systems and manufacturing systems).

We can also add to these organizations, the increasing participation of third parties in companies' technology ecosystems, including outsourcers, cloud providers and suppliers of "intelligent" industrial product.

##### 4.1. Dissipating Energy

With the three previous cornerstones in mind, we analysed what we are seeing in most of our mining clients that still lagging behind in the Digital transformation, and in general we identified that:

- their environments are poorly integrated;
- their organizations still miss the new capabilities and are not aligned on how to get there;
- they are not really prepared to deal with the new security threats.

The concern however, increases as the initiatives to explore digital or get prepared for it seem to be spread across the technology organizations with a minimal level of synergy and coordination among each other.

These companies usually present a combination of four or more of the following characteristics:

- There are several teams simultaneously and independently working on similar initiatives with low synergy among them.



- A great deal of time and effort is spent due to limited skills in new technologies such as Analytics and Cloud.
- Solutions being implemented at one site or operation are rarely being rolled out to the whole company.
- New technologies are being implemented and “dying” due to limited to none structured maintenance capabilities.
- Solutions are developed locally from the ground without the benefit of supporting technology platforms (e.g. common cloud, analytics or data integration platforms).
- Effort and time are spent on a broad set of opportunities and not necessarily on the more attractive ones.
- Initiatives are launched and conducted without the guidance of a clear corporate digital strategy and an integrated view of the technology architecture view (combined view of the IT and operations/automation environments).

These characteristics clearly depict the companies that are dealing with Digital Transformation on a distributed and non-coordinated way.

In most of the cases, this is the result of a fragmented governance within the company among the different business units, geographies and technology areas, each of them with a great level of autonomy in terms of deciding which technologies to adopt in support to their own operations.

The general consequence of this scenario is that a great level of effort and time is spent and results are in general local and limited. In other words, there is a great dissipation of energy that is not turned into effective business results.

The problem is not necessarily the organization itself, but much more the absence of a governance that drives the decisions in a way to assure the best outcomes at a corporate level based on well known trade-offs.

#### 4.2. Business Impact at a Corporate Level

On the other hand, companies that are presenting more consistent and relevant results of digital at a corporate level present a different profile.

In these companies it is possible more consistently find the following characteristics:

- A clear strategy and an integrated view of the technology architecture;
- A corporate governance that drives the key investments at corporate level;
- A consistent approach to investing in the foundations (e.g. platforms and integration layers);
- Better structured digital capabilities.

Here, the effect is exactly the opposite of the one found in the other companies. Here, companies are optimizing the effort and time spent on Digital Transformation initiatives and are getting more relevant results at a corporate level.

### 5. Conclusions: the lessons learned

We can consolidate the conclusions presented in the previous sessions on three main points:

- Gaining productivity is a must, but also a real challenge for the mining companies.
- Digital Transformation has the potential to be the determinant factor for gaining productivity.
- Only those companies that are able to establish coordination at corporate level will be prepared to carry effective digital transformation programs.

The coordination mentioned above can take many different forms in terms of governance mechanisms, organization structures and shared capabilities. The key point though is that the company effectively articulates a corporate strategy for Digital Transformation, and executes it consistently, as demonstrated by the companies that are getting more of it.

This corporate coordination however, should not be mistaken for a synonym of centralization.

The nature of a business organized by multiple business units and geographies and types of operations requires a high level of innovation and agility in technology solutions being delivered locally.

It means that the corporate and local solutions have to coexist. Being the corporate solutions focused on the bigger cross operations initiatives and on the foundation initiatives in a way that facilitates and directs the local solutions, without just killing them.

With that, Accenture presents our recommendation to the companies that are interested in getting the full value of Digital Transformation:

- Ask yourself where your company is in this journey;
- Make sure a Digital Agenda is set at a corporate level;

- Build the foundations and capabilities to gain agility;
- Orchestrate the innovation.

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