NATURAL RESOURCES

GAINING VISIBILITY AND CONTROL OVER MINING OPERATIONS: BENEFITS AND CASE STUDIES

ABSTRACT

Today the mining industry is facing economic challenges on many fronts, which are reinforcing the need to improve its operational practices and reduce its production costs. Operational stability, excellence and agility are important factors in achieving these goals. Achieving these three elements requires robust planning practices, strict adherence to plan, and visibility of planning and production performance across multiple departments and geographies. Mining companies and mining operations that lay the foundation beginning with stability will benefit by being able to introduce continuous incremental improvement and the ability to react rapidly to changes in the operating conditions and the market.

This paper highlights how excellence in business governance is a key enabler for mining organizations to deploy solutions proven in other industries such as manufacturing in order to gain visibility and control over planning and production. In this scope, several key aspects include: collaboration across the organization, synchronizing operations across multiple departments in order to gain visibility into the current status of the work underway in the mine; improving work and production management by tracking mining activities and responding to variances in real-time.

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By employing dashboards and analytics using previously inaccessible or "dark data", a quick understanding of the root cause of any deviation to the plan is gained. Such dashboards can be tailored to the specific needs of different roles such as: CxO, VP of Planning, VP of Operations, and mine, geology, and engineering managers, among others.

Finally, using real case studies this paper demonstrates how using a governance platform supports the adoption of the full digital mine of the future.

INTRODUCTION

Much has been said about the downward trend in the mining industry. The challenges are well understood: relatively low commodity prices and demand, higher financial leverage, and lower grades, among other problems. In response, well-regarded groups have identified industry trends that are emerging as a result of those challenges: adoption of lean practices, focus on innovation; adjustment to the new normal; corporate restructuring; strategic capital investments or cost control to increase productivity, to name a few.[1][2][3].

Even though the mining industry faces challenges that are unique to its value chain, most of its problems, if not all, have been experienced in other industries in one form or another. Solutions for such problems have been put in place already by leaders of other industries. What can mining executives do to effectively execute on the trends that have emerged as the solutions to the problems in the industry to achieve their operational objectives?

METHODOLOGY

We focus on two cases that have resulted in increased visibility and control over operations; the first one is from the nuclear energy industry to demonstrate applicability outside mining, We outline here a framework to use as a starting point, then analyze the target company objectives, assess the problems to be solved, and review how the corrective actions were implemented to achieve the intended results.

The framework. Taking a page from other industries

For mining companies to effectively execute on lean practices, increase productivity, and innovate, we propose using a virtual mine framework based on a three-tiered approach: Operational Stability, Mine Execution Excellence, and Business Agility (see figure 1).

Operational Stability

In the McKinsey paper "Productivity in mining operations: Reversing the downward trend" [4], Ajay Lala et al. talk about embedding effective management operating systems at mines. This is about reaching greater control of mine operations; it is about reaching operational stability. With Operational Stability mining companies can bring consistency to their operational performance by reducing variability through the stabilization of processes.

Mine Execution Excellence

Once stability has been achieved, mining companies can develop their capabilities with continuous improvement processes to reach what we call Mining Execution Excellence. By understanding how business processes work globally, companies can easily share best practices across their operations and achieve significant levels of continuous improvement.

Business Agility

Finally, there is no question that innovation is a critical ingredient for success, but planning for innovation is easier said than done. While innovation programs should be put in place, we argue that to truly reach the ultimate goal of maximizing value for stakeholders, mining companies need a catalyst that will let them achieve results consistently. This is where Business Agility comes into the picture. It is the ability to identify, simulate, validate, and adapt business processes more robustly to changing conditions and systematically address the sources of high unit costs and low output per resource to improve performance indicators.

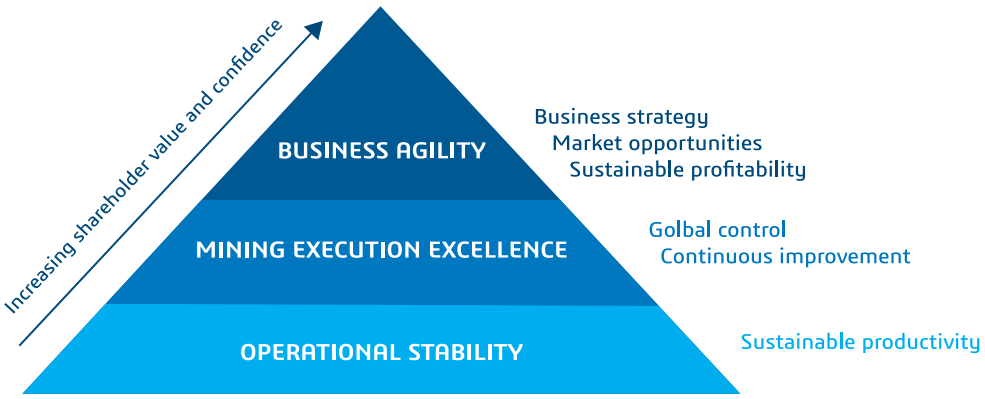

Figure 1. A virtual mine framework. Dassault Systèmes

Reaching Operational Stability

How can mining companies truly gain visibility and control over their operations? By clearly defining business processes that enable mining and plant operations to function and implementing the change management needed to put such business processes in practice. In addition to that, by adding a governance foundation to allow the change to take effect and be managed throughout its lifecycle. Take for example mine planning. Figure 2 represents the top level processes that a VP of Mine Planning would follow. Going from resource exploration and modeling all the way to budgeting, and considering that reconciliation and control are integral parts of each stage, these business processes set a good basis for how mine planning can be structured. However, a transverse layer of governance that can sustain those business processes is required to ensure the success of the program.

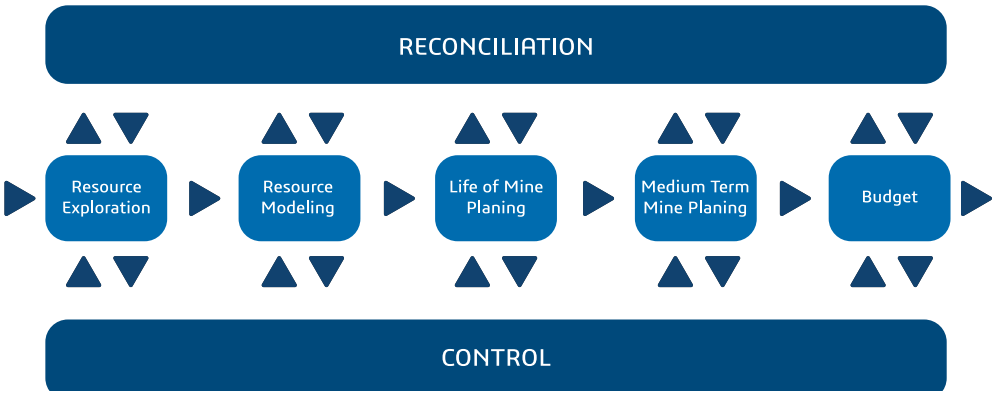

Figure 2. General top level business processes for mine planning. Dassault Systèmes

We argue that such governance layer has to contain the following elements:

- Collaboration across the enterprise
- Excellence in business planning
- Compliance to corporate commitments
- A visualization and control center

In the case studies section, we present real examples that demonstrate how implementing these governance elements provide the structure to achieve Operational Stability.

Collaboration across the enterprise

Digital enterprise collaboration provides management of the most important facts and estimates of the business, from planning to execution, enabling companies to handle large amounts of data effectively. Managing the digital lifecycle of the geological model, mine design, and planning processes is not enough, business requirements and assumptions also need to be documented, versioned, and controlled to ensure full consistency and traceability of all of the digital assets of the operation. Global access to up-to-date information eliminates re-work, speeds up work cycle times, and makes it easier to identify risks.

Excellence in business planning

With program and project management solutions that are tied directly to the digital assets (models, requirements, and assumptions), companies can manage the complex mine planning and execution activities in a collaborative environment. Internal and external stakeholders can work together with the most up-to-date information. Access is controlled by role and task for data integrity and accountability. A single version of the truth and an integrated master schedule across design, engineering, procurement, construction, and operations, permit a superior ability to manage scope, cost and schedules.

Compliance to corporate commitments

Mining companies, similar to those in other industries, have to adopt and comply with industry standards (ISA-95, JORC Code), governmental permits and regulations, and community guidelines or constraints. In addition, companies must manage their intellectual property and quality control systems. Early understanding of the regulatory requirements in the planning and innovation processes avoids rework and non-compliances that can be found late in the delivery process.

Appendix A presents a general workflow that includes approval gates in mining operations. Making corporate compliance part of the virtual mine framework of an operation enables an integrated decision support system that not only helps trace choices made in the past, but also allows for analysis of multiple scenarios in the future.

A visualization and control center

Finally, there are many systems and platforms available in the market that aggregate data for visualization or control. Such systems have been built specifically for financial transactions, fleet management, or maintenance. There is a purpose and place for such specialized systems, and some of them will support the quest for operational stability.

One of the challenges we see in mining companies in regards to data aggregation, also supported by Deloitte in its top 10 issues for mining companies in 2016 [1], is the complexity of dealing with multiple systems and the uncertainty that highly refined reports and dashboards truly represent the underlying business processes and their respective models, requirements, and assumptions. A scalable, integrative platform that enables collaboration, planning, and compliance, can solve this problem. A platform that can interoperate with existing and diverse systems to bridge silos across data sources and functions. Companies in manufacturing and process industries that have adopted such platform have reached high visibility and control of their operational performance in order to support the reduction of process variability, to implement continuous improvement, and to reach a higher level of agility in their operations.

ANALYSIS AND RESULTS

We present two cases, in which a governance layer of enterprise collaboration, business planning, and visualization and control has successfully been implemented to achieve operational objectives. The problems solved in these cases have direct applicability to most mining companies.

Case One: Nuclear plant construction

A well-known nuclear power plant builder that had to comply with strict safety standards. Its objectives were to increase collaboration and integration among engineering, construction planning, and procurement functions, and to reduce construction time and costs. The company

required digital solutions to increase plant reliability and safety. Before having a system to integrate engineering, design, and construction, their data was dispersed across different computers that didn't support exchange or collaboration throughout the company. There were construction delays, schedule shifts, and resources left idle due to inaccurate planning. The lack of an integrated solution led to rework on the construction sites.

Collaborative design, engineering, and project management

To achieve operational stability in their construction projects, this nuclear power plant builder worked with Dassault Systèmes to implement a solution that integrated design, process engineering, and construction in a unified plant model. The process started with an assessment of the business practices and technical capabilities to uncover the problems at the source. Different scenarios were considered and areas for control and improvement were identified. For example, the ability to build each nuclear station block within a relatively short time was identified as an area of opportunity.

The resulting solution increased functional collaboration, consistency, and visualization of their processes reduced the overall duration of the construction projects. Their unified approach to nuclear plant construction allowed them to be prepared to build new nuclear blocks that otherwise they couldn't build. With the design and engineering work coordinated in a common platform, they then focused on reducing costs associated with power unit design, construction, operation, maintenance and decommissioning. Because models were always up to date and accessible to the right people, engineers could validate and optimize their designs more efficiently and within the demands of their construction projects.

Learning experience for the mining industry

The case of nuclear power plant builder highlights prevalent challenges in the design, engineering, and construction areas of large projects. Similar to nuclear power companies, the mining companies have to develop a mine with an initial set of requirements and assumptions in a capital intensive project. This work is usually performed by Engineering, Procurement, and Construction companies, or EPCs. The lack of integration and collaboration across disciplines and between the contractor and the owner operator contribute to large projects missing their targets. According to a Booz Allen Hamilton survey of energy leaders, capital projects frequently exceed both schedule and budget by more than 10 percent. [6] With a governance layer that improves operational stability, companies in the mining industry can improve their collaboration with contractors, but more importantly, they can ensure that EPCs deliver on their promises.

Case: Underground Mine

An underground mine had objectives were to double production, from 1 to 2 million tons per year, and achieve a 44% improvement in unit cost; all without the addition of new mine production equipment. A mine improvement program was created to achieve these objectives. The program consisted in the implementation of a new operating model that covered planning, scheduling, and execution. To implement the program, new technologies and software capabilities were required. The mine developed technology in-house and partnered with Dassault Systèmes to implement a production management system.

Visualization and control for shift management

In an underground mine, multiple tasks have to be accomplished concurrently. Mining, maintenance, and logistics activities with hundreds of tasks, people, and equipment, have to be coordinated during a shift. The progress of tasks is usually known at the end of the shift when a report is made. This leads variability and missed opportunities to correct the course when it is known that a task cannot be completed.

Taking a concept from the manufacturing industry, the mine introduced a Short Interval Control (SIC) process. Rather than waiting for the shift to end, with SIC, the shift is split into short intervals and real-time production information is used to update the status of tasks at those intervals. With a central monitoring and control system, the mine not only ensured that the shift was executed as planned, but also was able to react quickly to operational deviations. A visualization and control center with data aggregated from disparate sources in a common platform makes possible the implementation of new methodologies to achieve Operational Stability.

CONCLUSION

Mining executives can benefit from implementing solutions that have already been proven in manufacturing and process industries. We proposed using a virtual mine framework that focuses on Operational Stability, Mine Execution Excellence, and Business Agility. A governance layer has to be in place in order to reach Operational Stability.

We presented two cases. First, a company in the nuclear power plant industry that applied enterprise collaboration and business planning to get projects under control. Then, a mining company utilized a visualization and control center to get shifts under control with a Short Interval Control process.

The solutions applied by the two companies form a governance layer for business excellence that increases visibility across key stakeholders, and ensures traceability and consistency of all sources of information. This opens the door for continuous process improvement programs, an integrated decision support environment, and the handover of digital assets (digital mine) that will lead mining companies to truly gain visibility and control across their operations.

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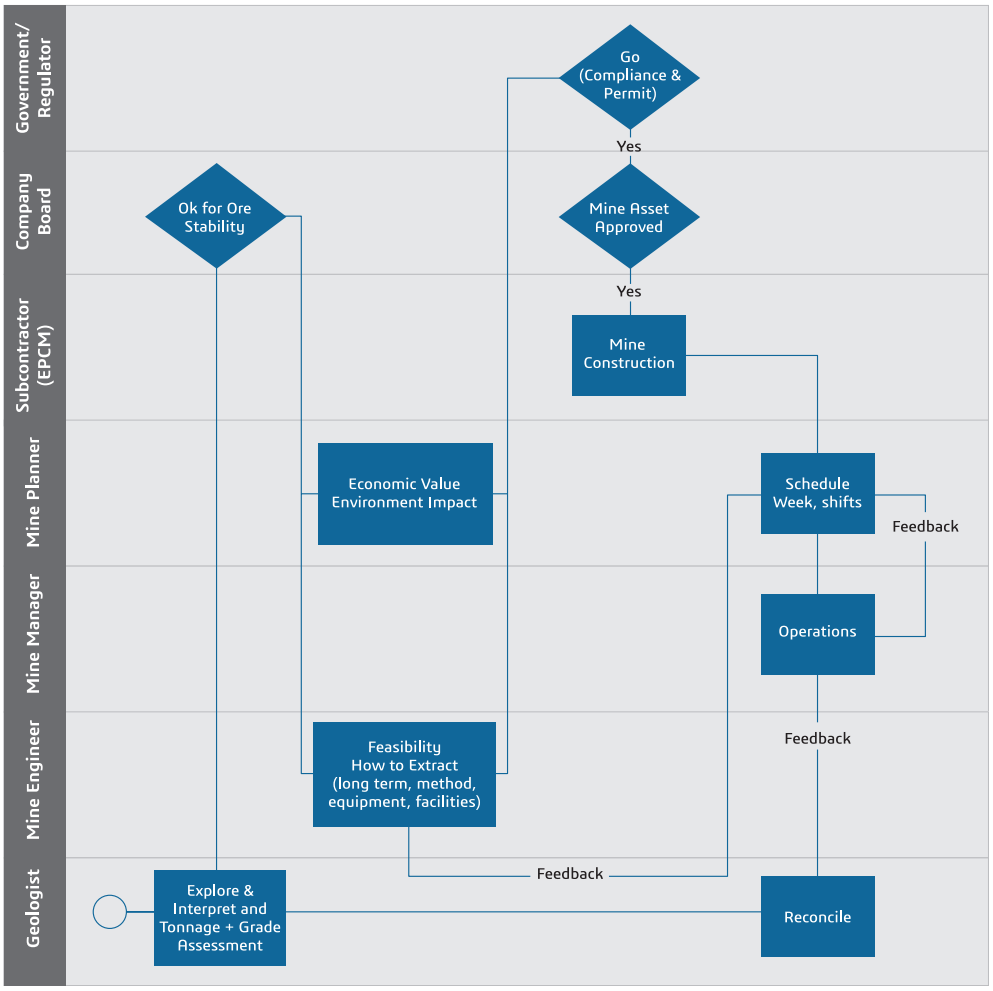
International Society of Automation, Enterprise-Control System Integration, ISA-95

Joint Ore Reserves Committee, The Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves, JORC Code

APPENDICES



APPENDIX A.
Representation of an approval workflow. Dassault Systèmes

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