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## Performance Improvement in Mining Iron Ore Mining and Processing

### Situation

Our client, a large producer of iron-ore pellets in North America, had been experiencing rising costs, threatening profits and strategic flexibility. In response, the organization had begun an aggressive cost savings program (\$100 million cost savings over three years divided among their operating units) involving a combination of internal and external teams. The organization's concern, however, was twofold:

- How to have visibility of the improvements underway among the various teams (the “what and how”), and
- How to get the organization to see the “big picture” for the future of the organization.

To this end, the client sought to partner with an organization that had a robust methodology for not only identifying and prioritizing improvement opportunities, but also implementing them in a sustainable way. Implementation Engineers were selected to help the organization close its performance gaps through the use of its Implementation Engineering<sup>SM</sup> and Implementation Execution methodologies. In addition to process improvements, the organization needed an Implementation Execution Roadmap and a means of maintaining visibility over all the improvement activities taking place. Furthermore, the client had selected Lean Six Sigma as their primary process improvement methodology and a secondary goal was for Implementation Engineers to mentor their internal Black Belt / Green Belt resources in the methodology, particularly the Define-Measure-Analyze-Improve-Control (DMAIC) project structure.

### Approach

Implementation Engineers was initially invited to execute an Implementation Engineering<sup>SM</sup> “proof-of-concept” project at Mine A where the primary problem was insufficient balling-drum throughput. This represented a major financial opportunity for the client as the suboptimal throughput necessitated the operation of a larger number of balling drums than otherwise necessary. Using the Lean Six Sigma methodology with Value Stream Mapping, measurement systems analysis

and designed experimentation, Implementation Engineers successfully demonstrated a sustained throughput of 110 tons per hour (TPH) on one drum, a 38% increase over the pre-improvement throughput. Extending this improvement to six additional balling drums would enable the client to shut down five other drums, while maintaining a constant throughput, resulting in a savings of \$3.6 million per year.

Following the success of the balling-drum project at Mine A, Implementation Engineers was then tasked with improving the furnace throughput and the management system at Mines B and C respectively. The Implementation Engineering<sup>SM</sup> team at Mine B analyzed the furnace operations and determined that the root cause of the suboptimal furnace throughput lay in the upstream balling-drum operation, which was feeding poor-quality pellets into the furnace. Using a similar Lean Six Sigma approach to that employed at Mine A, the team optimized the balling-drum operation and improved pellet quality to the extent required by the furnaces. The net result was increased furnace throughput from 235 TPH to 250 TPH with an estimated financial benefit of \$3.9 million per year.

Meanwhile, the Implementation Engineering<sup>SM</sup> team at Mine C conducted a comprehensive Value Stream Mapping (VSM) analysis and identified a list of 114 improvement opportunities (totaling \$108 million increased annual revenue) encompassing all aspects of plant operations, including for example:

- Improve Haul Truck Availability and Maintenance
- Increase Primary Mill Uptime (15%)
- Increase Pebble Mill Uptime (29%)
- Increase Mill Line Throughput (10%)
- Increase Filter Efficiency
- Decrease Kiln Downtime
- Decrease Kiln Fuel Usage
- Increase Primary Mill Throughput (30 – 40 tons/hour)

## **Implementation Execution Project**

After a review of the “big picture” opportunities outlined in the VSM, plant management decided that one of the most urgent requirements was for an improved and sustainable plant Improvement Operating System. The operation had been struggling for the past several years to meet financial and production expectations. The management staff tracked numerous performance measures, but the site did not have an integrated system to Define, Measure, Analyze, Improve and Control (DMAIC) the fundamental forces at work in their business. It



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was evident that the lack of visibility into their day-to-day processes had contributed to the past and current operational performance problems. These problems culminated in a \$65 million shortfall against the previous year's production commitments.

The Mine C Implementation Execution team implemented a new processing plant Improvement Operating System with the following elements:

- *Key performance indicators (X's)* that drive the overall business performance (Y's).
- A balanced *score card* that summarized plant performance in seven categories: Safety, Operations, Maintenance, Cost, Product Quality, Environment, and Human Resources.
- A *digital cockpit* with time series KPI graphs by category.
- *Graphical analysis tools* that explained variances to the operating plan and lost production.

The Mine C Implementation Execution team also instituted three management processes to drive performance improvement:

- A *Management Operating Review Process* to analyze KPI data, create contingency and recovery plans, and report performance in a bi-weekly Operating Meeting.
- A *Steering Team* to review business needs from the results of the Operating Review and project ideas brought forth by Department Champions, rationalize the ideas, prioritize them, and align the resources with the activities and projects that deliver the most value.
- A *Continuous Improvement Project Tollgate Process* to review, scrutinize and revise projects to accelerate the results and ensure that the net benefits are real.

The net result of the improvements at Mine C was an estimated financial benefit of \$13.5 million per year and a reduction of safety accidents by 20%.

## Results

By the conclusion of the engagement, Implementation Engineers had successfully implemented improvement projects at three disparate locations resulting in multi-faceted operational improvements for the client with a combined financial benefit of \$21 million per year.