IMPLEMENTATION ENGINEERS
Dynamic Solutions in Action

Analyzing Constraints to Throughput
Open Pit Gold Mining and Processing

Situation

Our client a mid-tier gold miner had engaged Implementation Engineers to assist them in increasing throughput in the Mine and Mill operations. They had had historical difficulties in achieving the full potential production levels so we started with our Implementation Engineering service, emphasizing throughput optimization.

Approach

One component of our Implementation Engineering℠ methodology was to analyze, then document the operational capacity profile (see Figure 1). That profile clearly revealed that under current operating conditions and performance, even on the best days, the drilling operation could not meet its targeted demand, let alone on an average day. Although there were other parts of the operation that had constraints, the drilling operation was by far the largest one.

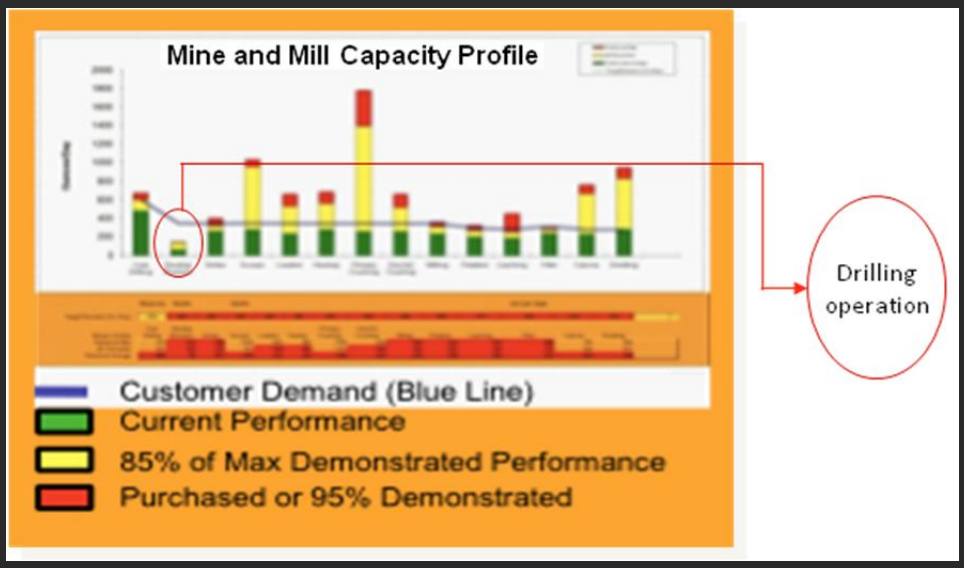


Figure 1: Operational Capacity Profile

In conjunction with creating the capacity profile, another part of our Implementation Engineering℠ methodology was to create a value stream map of

the operation (see Figure 2). The value stream map went into detail about the aspects of the processes which create value along the entire value stream in the mine and mill. In the case of the drilling operation, it provided us with insight into how the drilling tools and equipment performed as well as how the people performed their jobs.

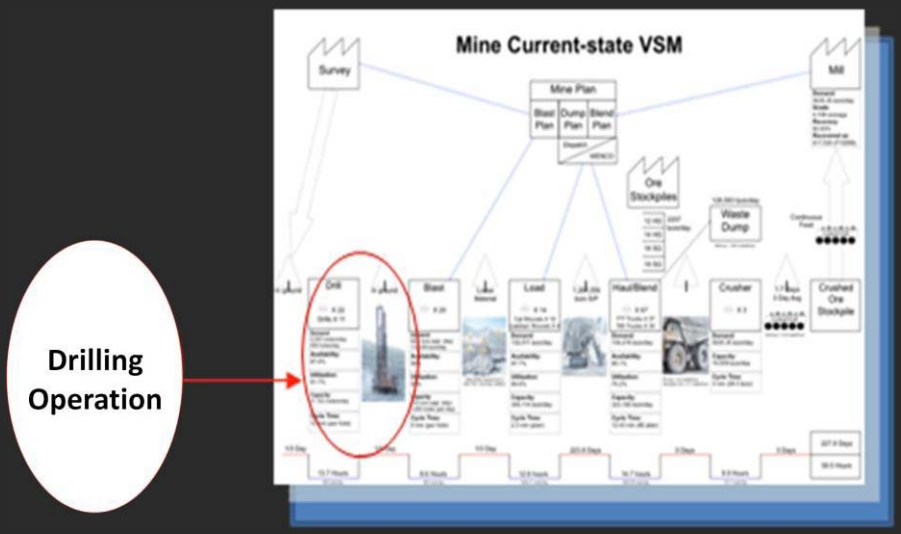


Figure 2: Value Stream Map

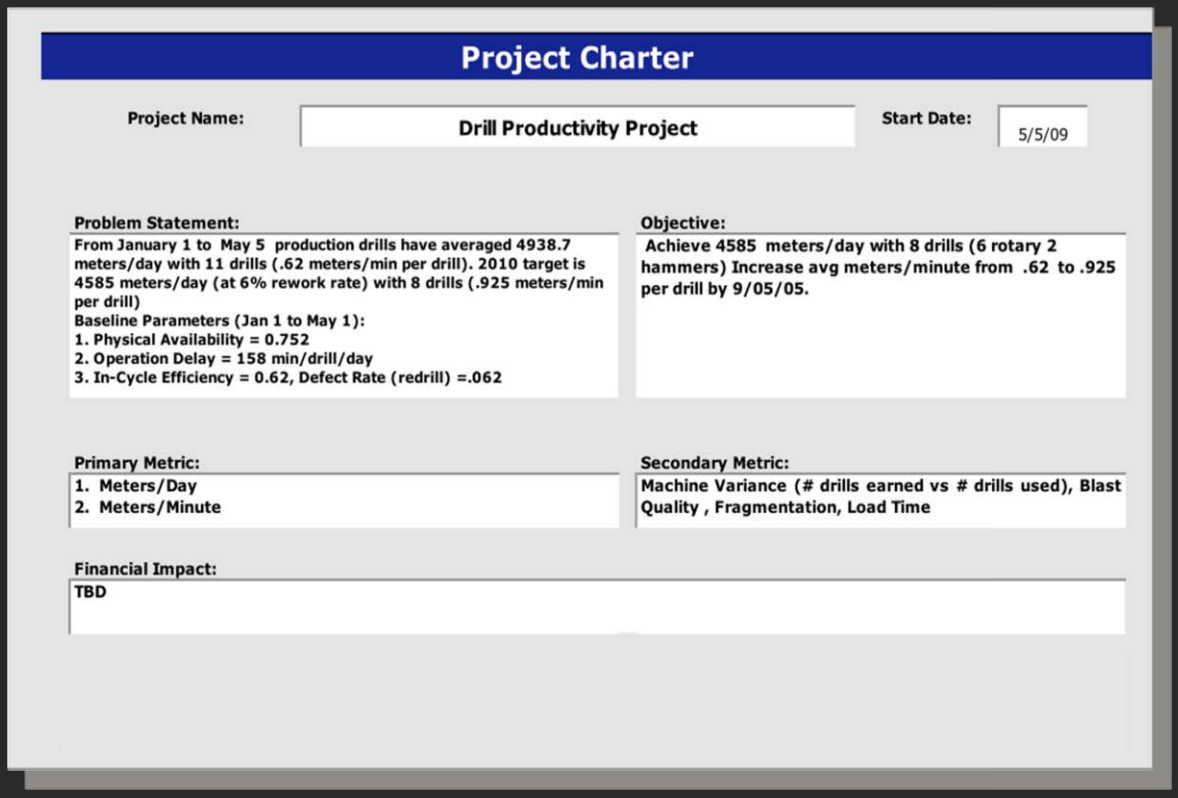
The value stream map led us to the conclusion that the lacking demonstrated capacity of the drilling operation was driven by two key aspects which were underperforming:

- Drill on pattern utilization at only 45%
- Drill penetration rate at only 0.73 meters per minute

Other aspects of our analysis across the value chain included producing process maps of the whole operation's current process (mine and mill) to identify key points of variability as well as process inputs, outputs and noise. An analysis of current and historical data was used to determine cause-and-effect relationships between process variables, which included was a measurement systems analysis to assess measurement capability.

All-in-all, the approach showed us what factors hindered throughput and why, reinforcing that the largest constraint was with drilling. A decision was made to start there with implementation, then once more throughput was achieved to move to the next constraint.

Therefore, we provided a project charter for the drilling productivity work before moving on to Implementation Execution (see Figure 3).



Project Charter

Project Name:	**Drill Productivity Project**	**Start Date:**	5/5/09

Problem Statement:

From January 1 to May 5 production drills have averaged 4938.7 meters/day with 11 drills (.62 meters/min per drill). 2010 target is 4585 meters/day (at 6% rework rate) with 8 drills (.925 meters/min per drill)
Baseline Parameters (Jan 1 to May 1):
1. Physical Availability = 0.752
2. Operation Delay = 158 min/drill/day
3. In-Cycle Efficiency = 0.62, Defect Rate (redrill) =.062

Objective:

Achieve 4585 meters/day with 8 drills (6 rotary 2 hammers) Increase avg meters/minute from .62 to .925 per drill by 9/05/05.

Primary Metric:

1. Meters/Day
2. Meters/Minute

Secondary Metric:

Machine Variance (# drills earned vs # drills used), Blast Quality , Fragmentation, Load Time

Financial Impact:

TBD

Figure 3: Project Charter

Results

Implementation Engineering[SM] returned to fulfill the above project charter and deployed its Lean Six Sigma expertise. The sustained results were as follows:

- Drill on pattern utilization increased from 45% to 65% via a Kaizen Blitz.
- Drill penetration rate increased from 0.73 meters per minute to 1.44 using a Six Sigma Design of Experiments (DOE).