**Analytics Projects at Caterpillar**

**Health Monitoring of Large Machines**

Un-mitigated faults in large engines propagate to become component failures that lead to costly downtime and mining trucks. LPSD is developing a health monitoring system that detects and isolates faults so that the truck owner can schedule preventative maintenance. LPSD uses its engineering domain knowledge and analytics models (classification trees, multivariate regression, Hotelling T-square, neural networks, and spectral analysis) to develop a health monitoring system to detect faults that affect critical components i.e., crank journal and main bearings, valve mechanisms, and fuel injection systems. The health monitoring work will be more fruitful as LPSD implements a system having (1) dedicated sensors to detect both symptoms of the precursors to faults, on large engines, and (2) reliable systems that transmit continuous data every day from large engines around the world.

**Advanced Condition Monitoring (ACM)**

Analytics in the Caterpillar Equipment Care Advisor solution is used to detect anomalies in data related to machine performance the health. The anomalies are used to make machine service recommendations targeted at improving machine utilization, life, and up time. These result in improved cost of ownership and satisfaction to customers. Another use of the analytics results is to channel results back to engineering for continuous product improvement

**Product Link Usage in Parts Forecasting**

Product Link enables convenient monitoring of important equipment information remotely to help increase productivity and reduce owning and operating costs for the customer as well as enabling key business processes for the dealer. Product Link not only presents catastrophic breakdowns, it gives equipment managers a huge edge in their daily responsibilities. In the study presented, Product Link data is used to help improved product forecasting and better inventory management. Inventory costs for service parts tie up approximately $2.1 billion per year in working capital, yet component service levels and inventory turns balance is not optimal. The move to autonomous machines and more widespread deployment of Product Link (PL) has the potential to greatly increase the availability of machine utilization data from the customer machine population. The study proves that simple measures like service hours and fuel consumption may provide statistically valid leading indicators to changing component demand. Improved component demand forecasting should have the following tangible business benefits: Reduced inventory cost at a given service level. Reduced transportation and expediting costs. Improved supplier confidence in forecast (more stability, less churn).

**Production Optimization at Customer Sites via Site Simulation**

Simulation is extensively used at Caterpillar to optimize machine offerings to our customers. However, there are many opportunities to use site level simulation, considering how different machines interact with each other and the surrounding environment, to maximize the utility of a fleet of machines at a customer site. Site Simulation can not only help understand customer operations but also identify bottlenecks, evaluate the impact of different options in the virtual world before implementing them with iron and dirt at a customer site. This presentation will share details and examples on how Site Simulation was successfully used by Job Site Solutions, as a part of the Production Optimization offering, to quarry customers.

**Maximize the Parts Availability within Global Mining**

Within the Expanded Mining service parts network, high value / low volume (HVLV) parts make up approximately 22% of the expanded mining parts portfolio. The high value and slow-moving nature of the HVLV parts requires a large inventory investment and significant holding costs to support customers. Under the sporadic demand, it becomes a challenge to develop an optimal stocking strategy that maximizes machine’s availability and productivity. This presentation talks about Network and Inventory Simulation that helps in optimizing and balancing customer support requirements of time to fill, availability and service level.