Transformation to a Predictive Enterprise Improves Plant Efficiency, Reliability and Safety

How Air Liquide reduced unplanned maintenance actions 95% over three years, representing millions of dollars in avoided cost and unknown savings in avoided lost production.

Jan. 11, 2012 Burt Hurlock, CEO, Azima DLI

Many large plants across the U.S. understand the potential for predictive maintenance programs to decrease unscheduled equipment repairs and downtime, and to ensure reliable delivery of critical services like power and light. Few large industrial enterprises have undertaken the kind of transformative work-culture changes that Air Liquide has pursued to measure and correlate risk, reliability, efficiency and safety across 112 plants.

The results are indisputable: unplanned maintenance actions reduced by 95% over three years, representing millions of dollars in avoided cost and unknown savings in avoided lost production. More importantly, Air Liquide has changed behaviors across a broad swath of its production operations by using web-based reporting tools and dashboards to measure program compliance, rank order risk, prioritize maintenance initiatives, and to raise general awareness about the health of production operations among executives and plant managers alike.

Air Liquide Large Industries (Air Liquide) is a member of Air Liquide Group, the world leader in gases for industry, health and the environment. Air Liquide Group is present in 80 countries with approximately 43,000 employees. The company stresses three core values: efficiency, reliability and safety. These core values have become the cornerstones of its ambitious and comprehensive predictive maintenance program -- a program that is second only to the U.S. Navy in both scale and the adoption of advanced machine condition monitoring capabilities.

In an industry where plants generally maintain autonomous and unspecified condition monitoring programs, Air Liquide chose a different path when it announced that it would partner with predictive maintenance analytical services company Azima DLI to drive a standardized machine health monitoring program across all of its U.S. plants. Through the lens of the Macondo oil well spill, Air Liquide's decision three years ago looks prescient, and puts it in the vanguard of leading companies moving aggressively to introduce consistent processes and procedures including machine health monitoring to reduce risk and improve safety and reliability.

However, Air Liquide has gone beyond machine health, and risk and cost management. The company has leveraged communications tools and infrastructure to drive a level of efficiency in production operations that will help it achieve its strategic performance goals.

Air Liquide's primary business need was creating a uniform methodology to ensure that its operations met customers' expectations for reliability, safety and efficiency. Air Liquide committed to changing its maintenance and reliability culture, with the goal of making comprehensive operations and machinery health information readily accessible

to all corporate stakeholders -- from plant managers to the executive suite -- so the health of production operations could be easily viewed, assessed and managed.

The reliability program partnership between Air Liquide and Azima DLI covers 112 plants across six business zones. Each zone has its own specific needs, priorities and budgets and has the flexibility to customize elements of their portion of the program.

Using Azima DLI's web-based Reliability Portal to centralize data analysis and maintenance recommendations, Air Liquide gained view-level access to its machine condition analysis program database. Operations and maintenance staff have direct access to program statistics, machine level analysis, and machine health history, either remotely or through any Internet-enabled device.

Innovative Custom Reporting and Metrics

Convinced that industry broadly underestimates the impact of predictive maintenance, Air Liquide and Azima DLI developed and maintain enterprise-wide performance metrics that are updated on a monthly and bi-annual basis. The existence and availability of the performance metrics are driving Air Liquide's cultural transformation using two relatively simple measures of success that are reported to all levels of management on a monthly basis:

- **Data collection compliance by plant/zone:** The data collection compliance report reveals whether data is being collected and tracked according to internal procedures and timing
- **Priority I and II Reporting:** Tracking unplanned maintenance initiatives inculcates cost-consciousness with the objective of reducing maintenance costs, and driving down the frequency of unplanned, time-critical maintenance actions issued as a result of incipient fault detections.

The correlation between collection compliance (resulting in early fault detection and resolution), and declining Priority 1 and 2 maintenance actions is indisputable -- a decrease of 95% over a three-year period, indicating that maintenance work orders are being generated based on earlier incipient fault detections that provide more time for routine scheduling of maintenance and repairs.

Composite Risk Index

The Composite Risk Index report was developed specifically to identify facilities with high potential for interruption to production operations, and to prioritize dispatching of maintenance resources and support. By leveraging information from the predictive maintenance program database, Air Liquide generates a numerical risk score for each site based on the following criteria:

- Number of identified faults
- Severity of identified faults
- Criticality of faults based on redundancy and production requirements

The risk index for each site is based on an assessment of the relative "riskiness" of each machine to that facility's production operations and safety, and is used extensively throughout zone and corporate management to identify areas of concern, and need-based maintenance activities.

The Value of Communication

Communication has been the vital ingredient to the success of the program, both internally and between Air Liquide and Azima DLI. The two companies rely on a number of scheduled and unscheduled communications including bi-monthly conference calls, customer satisfaction surveys, automatic alerting via the Reliability Portal, periodic training sessions and email newsletters.

Internally, Air Liquide has monthly, fleet-wide reliability conference calls with the Reliability Engineers assigned to each zone. These include the participation of corporate-level technical experts who support the Reliability Engineers responsible for implementing the reliability programs that are distinct to their zones. The two-tier structure captures and preserves the knowledge base originating throughout the company's fleet of plants, leading to better detected fault pattern recognition, and the efficient dissemination of best practices.

By collaborating on the development of ground-breaking performance metrics that serve the needs of both production operations and executive management, Air Liquide and Azima DLI believe they have successfully expanded the efficiency frontier in production operations and increased the potential yield of the Air Liquide installed fleet. Using state-of-the-art predictive technologies and thoughtful communications strategies, Air Liquide is transforming its culture and introducing behaviors that will be vital to sustaining a low risk, reliable, safe and truly predictive enterprise.

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