IVARA

CASE STUDY

Ivara's Advanced Analytical Technologies Support Strategic Capital Planning and Maintenance Optimization at Gallatin Steel

Gallatin Steel is a leading flat-rolled carbon steel producer that employs approximately 430 people. Located in Ghent, Kentucky, the company is a joint venture between ArcelorMittal and Gerdau Ameristeel.

The Situation

Gallatin Steel is experiencing dramatic market growth. The more the company can produce the greater the revenue and return on their capital investment. The bottom-line impact that unexpected equipment failure has on production capacity is well understood by Gallatin.

Figure 1: Ladle Metallurgy Facility

As a result, Gallatin is a leader in employing innovative technologies and practices to achieve optimal equipment performance. For example, the company was the winner of Uptime Magazine's prestigious PdM Program of the Year Award. In addition, Gallatin leverages Ivara EXP Enterprise asset performance management software. EXP collects, consolidates, analyzes and acts on the volumes of condition data resulting from Gallatin's PdM technologies. The software is a key enabler of Gallatin's strategic focus on condition-based, proactive maintenance.

Continuous improvement is a closely held corporate value at Gallatin Steel. As new opportunities emerge to further improve equipment performance Gallatin considers whether they can be integrated with their existing programs. With the availability of new analytical tools offered by Ivara, Gallatin seized the opportunity to adapt them into their existing maintenance environment. The advanced analytical technologies include the Ivara Weibull Analysis and Ivara Life Cycle Cost Analysis tools.

The Situation:

» Optimize equipment performance to meet increased production demand

The Opportunity:

» Improve the effectiveness of existing maintenance programs for Furnace Roof Lift Cylinders and optimize asset lifecycle for Fleet of Liebherr cranes

The Solution:

Leverage Ivara's new analytical technologies:

» Ivara Weibull Analysis
  - Determine failure patterns to recommend the optimal maintenance policies for Furnace Roof Lift Cylinders

» Ivara Life Cycle Cost Analysis
  - Determine optimal economic life of fleet of Liebherr cranes

The Results

Weibull analysis of Furnace Roof Lift Cylinders

- Optimize PM replacement interval of West Lift Cylinder to reduce failure and downtime incidents by 11%
- Optimize PM replacement interval to reduce failure and downtime incidents by 40%, and eliminate 10% of annual maintenance costs

The Results

Life Cycle Costing Analysis of Liebherr Cranes

» Continue to operate existing Liebherr 974A economically for approximately 3 more years on a low duty cycle to extend its productive life.

» Operate new Leibherr 974B crane for 8 years to optimize average annual cost of ownership

Ivara Weibull Analysis

Weibull Analysis is a statistical tool that predicts the future failure patterns an asset, based on historical asset data. The tool then recommends the optimal maintenance strategy to manage those asset failures.

Ivara Life Cycle Cost Analysis

Lifecycle Costing Analysis allows organizations to establish the economic life of an asset to support capital planning. The tool determines whether to repair or replace an asset, as well as establish the equipment's optimal replacement time.

The Opportunity

To optimize the maintenance planning of its fleet of Liebherr cranes, Gallatin Steel applied the Ivara Life Cycle Cost tool. The company decided to leverage the tool's structured methodology to determine:

1. How long it is economically viable to keep its existing crane running—the Liebherr 974A
2. What is the optimal economic life of its new crane – the Liebherr 974B

Gallatin also decided to apply the Ivara Weibull Analysis tool to validate and recommend improvements to the existing maintenance programs of its South, West and East Roof Lift Cylinders. These cylinders are critical to.the operation of the Ladle Metallurgy Facility (LMF) and can impact a key process bottleneck when they fail. The Weibull Analysis would be used to:

1. Predict the future failure patterns of the Roof Lift Cylinders
2. Recommend the optimal PM replacement policy for each

The Solution

The initiative began with a Life Cycle Cost Analysis of Gallatin's Liebherr cranes.

Data Mining

Gallatin leveraged the historical equipment information from its EAM system, such as rolling hours, maintenance costs and operation costs per year to secure the data inputs to perform the analysis. Also required were the future values of those same data inputs, which were estimated by Gallatin experts based on the historical asset data.

In addition to the asset related data inputs, the Life Cycle Cost Analysis tool required the following economic inputs: inflation rate, tax rules and discount factor.

"Ivara's statistical tools will help us minimize costs and downtime and improve reliability."

The Results –Life Cycle Costing Analysis

The recommendations resulting from the Ivara Life Cycle Costing analyses of Gallatin's Liebherr cranes showed that:

Liebherr 974A:

» Gallatin can continue to operate the existing Liebherr 974A economically for approximately 3 more years on a low duty cycle to extend its productive life. If Gallatin is capital constrained and/or needs the capacity, the analysis justifies continuing to operate the Liebherr safely and economically.

Liebherr 974B:

» For the Liebherr 974B, the lifecycle costing analysis suggests that the economical life of the Liebherr crane in the operating context at Gallatin is 8 years. Any deviation from this optimal replacement time would increase the asset life-to-date annualized cost.

» The 8 years optimal replacement time of Liebherr 974B can be considered as the initial optimal replacement cycle of any similar new Liebherr.

Using the Life Cycle Costing economic model, Gallatin can now optimize the life of their capital assets as well as proactively plan capacity and capital for the long term. Gallatin will now retain an asset, such as their new Lieberrher crane, long enough to get the most possible useful life out of it, but not so long that increasing costs of aging outweigh the value of the additional life.

"We now have the intelligence to move forward with the confidence and knowledge to make better informed decisions to improve our bottom line."

Figure 2: Liebherr Crane

The Solution –Weibull Analysis

Gallatin conducted a Weibull Analysis on its West, East and South LMF Roof Lift Cylinders to determine their future failure pattern—wear out failure, random failure or infant mortality failure—and then recommend the optimal replacement policy for each.

Data Mining

Similar to the Life Cycle Costing analysis, Gallatin leveraged the rich repository of asset information within its EAM system to secure the data necessary for the Weibull Analysis. Historical work orders provided the best source of data.

With an observation period beginning January 2002 to March 2008, the data mining exercise determined the life span of each cylinder as well as cause of the cylinder replacement, whether through a scheduled PM task or due to a cylinder failure. Gallatin now had the information required to conduct a Weibull Analysis for the LMF Roof Lift Cylinders.

Collective vs. Individual Weibull Analysis

The failure analysis was initially performed on the full set of life and failure data for all of the cylinders, but the findings indicated an inconclusive result. More detailed analysis leveraged Ivara's sub-analysis capability to reveal that the failure patterns were distinctly different for the various cylinders.

This prompted Gallatin to investigate and it was determined that the locations of the cylinders on the LMF roof exposed them to varying heat levels which affected their life expectancy. This finding allowed Gallatin to establish of an optimal maintenance strategy for each individual cylinder to improve overall system reliability.

"We believed that all of our cylinders operated similarly. We were very surprised to find that their location had an impact on their life span," says Jeff Stegemiller, Maintenance Reliability Team Leader, Gallatin Steel. "This told us that there are factors, other than maintenance, that affect asset performance."

The Results –Weibull Analysis

The recommendations resulting from the Weibull Analyses of Gallatin's LMF Roof Cylinders indicated that:

LMF Roof West Lift Cylinder:

» The expected time to failure for the West Cylinder is 318 days and it fails as a result of wear out. The results showed that there was a significant variation, 228 days, in the life-span of this asset.

» Gallatin Steel should continue a preventive time-based replacement strategy, which is appropriate for wear out failures, but can consider changing its current PM

replacement interval from annual to every 293 days. This will result in marginal maintenance and operating cost savings, but more importantly will increase reliability and reduce failure and downtime incidents by 11%.

LMF Roof East Lift Cylinder:

» The expected time to failure for the East Cylinder is 289 days and it also fails as a result of wear out. This cylinder is subjected to the highest degree of heat.

» Gallatin Steel should continue it preventive time-based replacement strategy but change the interval from annual to twice annual (optimally 183 days). This will save approximately 10.06% per year in maintenance and operating costs, but more importantly will also improve reliability and reduce failure and downtime incidents by 40%.

LMF Roof South Lift Cylinder:

» The data mining exercise for the South Cylinder indicated that the failure pattern was random. This cylinder was subjected to the least amount of heat.

» A preventive maintenance program had been in place since 2004. The few failure incidents available for this asset took place before 2004 when a run-to-fail maintenance strategy was in place. While the Weibull Analysis results predicted an infant mortality failure pattern to occur, the two distinct maintenance policies that were in place during the lifetime of this asset made the results unreliable.

» As a result, it is recommended that Gallatin continue its current PM schedule and gather more accurate data to find the failure pattern of the South Cylinder and, in turn, determine its optimal maintenance policy.

Additional Findings:

» The variability in the life spans of the East and West LMF Roof Cylinders indicates there is randomness to their failure patterns that compromises the reliability of the optimal PM schedule.

» To reduce this variability and improve overall reliability, it is recommended that Gallatin augment the existing PM program with condition monitoring to support early detection of impending failure.

» To determine the optimal condition monitoring activity and to identify the fundamental reasons of the West and East cylinders lifetime variability, it was recommended that Gallatin perform an Ivara RCM2 or MTA analysis.

Conclusion

Ivara's Weibull Analysis tool helped Gallatin validate and optimize the existing maintenance strategy of its Roof Lift Cylinders to extend asset life and ultimately improve operational performance. Ivara's Life Cycle Costing tool allowed Gallatin to quantitatively determine the economic life of its Liebherr Cranes given their maintenance costs. As a result, Gallatin can better plan crane capacity and capital to support the company's business objectives.

Commenting on the analyses, Stegemiller states, "Ivara's statistical tools will help us minimize costs and downtime and improve reliability. The recommendations forced us to rethink our maintenance strategy. We now have the intelligence to move forward with the confidence and knowledge to make better informed decisions to improve our bottom line."