Arcelor Mittal Burns Harbor Operation Uses Ivara EXP Enterprise to Achieve $2.1 Million in Savings in One Year

The ArcelorMittal USA Flat Roll Operations is comprised of 12 operating facilities employing over 17,000 people. The World Class Equipment Reliability (WCER) team at the ArcelorMittal Burns Harbor Hot Strip Mill have achieved very dramatic results in a 1 year period. Total savings in 2010 were $2,076,900. Other positive benefits include increased safety and a cleaner work environment.

Situation

During 2007, it was determined by senior leadership that in addition to investing capital in production equipment replacement or upgrade, a complete and consistent reliability business process would be developed and implemented and coupled with world class reliability practices and tools to reap the full benefits of any capital expenditure.

To launch their World Class Equipment Reliability (WCER) effort, ArcelorMittal-USA formed a central team with members from each US site. They partnered with Ivara to learn and utilize the renowned Ivara reliability process, practices, technology and methodology. This central team was trained by Ivara consultants and the team members deployed to their plant site to launch the WCER initiative within the specific business unit(s).

The ArcelorMittal Burns Harbor Hot Strip Mill

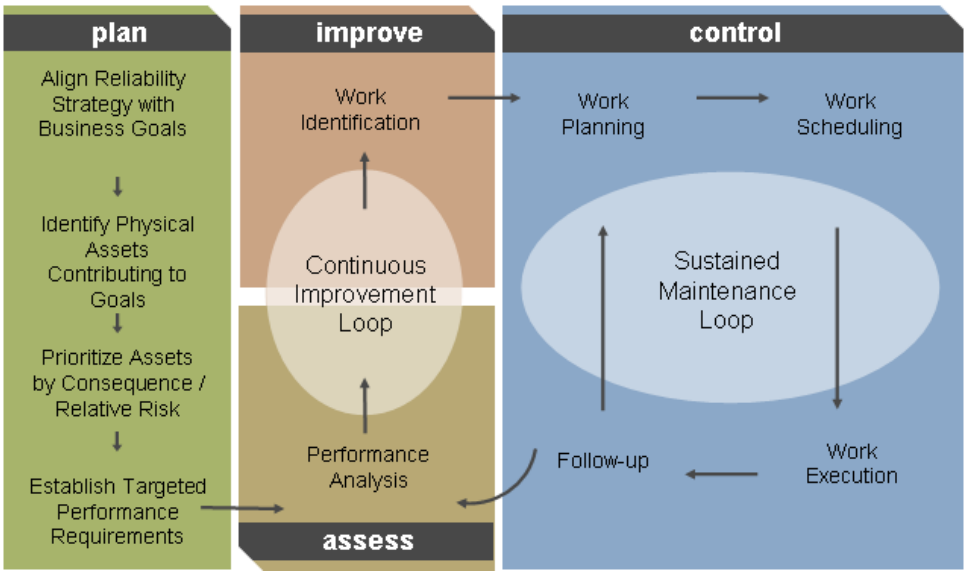
The objective of the training and coaching was to prepare the AM-USA central team members to be the internal WCER trainers and coaches for personnel throughout their operations. This development effort was completed in 2009 leaving each plant site with a central WCER team of internal reliability practitioners to drive and support their reliability improvement activities going forward.

The Ivara EXP Enterprise software was selected as a tool to support the AM-USA WCER implementation. The software was installed on their corporate servers using a single database for all US operations. In order to effectively manage the full scope of the WCER business process, a custom interface to the Tabware computerized maintenance management system (CMMS) was designed, tested and implemented.

In 2009, the Burns Harbor Hot Strip Mill (HSM) operation was identified as a high priority candidate for WCER implementation. It was experiencing an average delay rate of greater than 22 percent. In order to achieve the 2010 business plan of 17.58 percent average delay rate, significant improvements in production equipment reliability were necessary. Through much of 2010, the Hot Mill was not operating at full capacity. However, as economic conditions have improved, the production requirements for the facility have increased significantly. This opportunity was another reason to take action to reduce the high delay rate for the HSM in a sustainable manner.

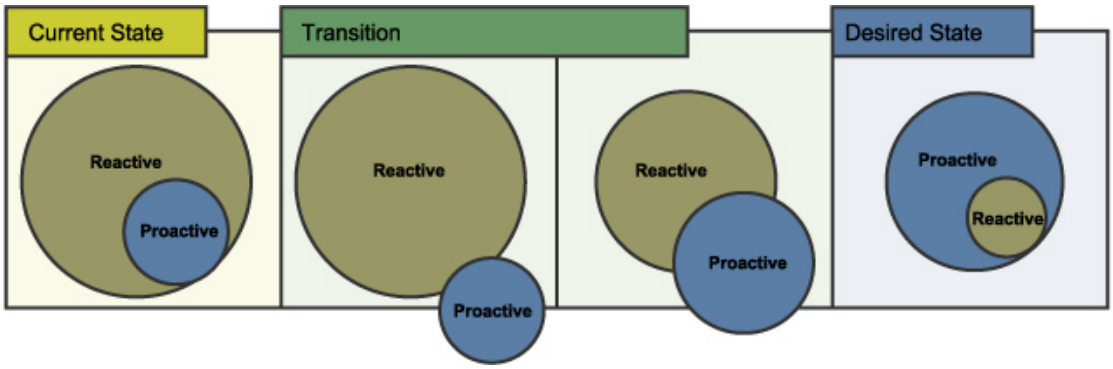
Solution:

To begin addressing the reliability issues within the Hot Strip Mill at Burns Harbor, a team was assembled to focus exclusively on applying the WCER approach and methodologies within this business unit. This began with the implementation of a proactive asset management business process. The initial area of focus was the Finishing Mill which consistently experienced the highest delay rates for all of the Hot Strip Mill.



ArcelorMittal WCER Asset Management Business Process

Critical to success of the program was ensuring that the HSM WCER team, which represented 6% of the total maintenance workforce, be able to focus *exclusively* on proactive activities and not be pulled away to deal with day to day reactive duties. Area leadership demonstrated their support of the improvement effort by dedicating a total of 10 full-time resources from within the Hot Strip Mill to the WCER effort. These resources included 7 individuals from the HSM Maintenance group, 1 from Operations and 2 from the Operations Technology group. In addition, an external resource was brought in to lead the effort in the role of Asset Coach.



The Process of Moving From Reactive to Proactive – How ArcelorMittal Successfully Made the Transition

The Burns Harbor Central Reliability Team provided WCER skills training and coaching to the HSM team members and ensured that the improvement effort was performed in accordance with the overall AM-USA World Class Equipment Reliability standards.

In preparation for the effort, training profiles and collaterals were developed to support all of the key roles within the WCER organization. Where possible, computer based training that incorporated knowledge testing was used to deliver the skills training. This was supplemented with classroom training as needed to fulfill role requirements. All personnel within the HSM-WCER team have a competency profile that identifies the training they have completed and the certifications they have attained in their development. Providing comprehensive skills training followed by field coaching has effectively prepared this team to deliver strong results while also enabling them to educate other personnel in the Hot Strip Mill on the value of a proactive approach.

Team Roles and Responsibilities

The HSM-WCER team was built to ensure the delivery of all elements of a world class equipment reliability business process. Role responsibilities are as follows:

- Asset Coach (1 position) – Responsible to coordinate overall WCER development and implementation effort for HSM.
- Reliability Practitioner (2 positions) – Responsible to facilitate all of the work identification activities (RCM – Reliability Centered Maintenance, MTA – Maintenance Task Analysis, CII – Current Inspection Implementation, and RCFA) used to build technically valid maintenance programs for production equipment.
- Equipment Specialist (2 positions) – Responsible to implement the action plans recommended by RCM/MTA analyses in the form of indicators, inspection routes and corrective tasks within the Ivara EXP Enterprise software. Also responsible for the acknowledgement of indicator alarms within the EXP software and the continuous reliability improvement of production assets within their area.

- Equipment Inspector (2 positions) – Responsible to perform the equipment inspections following the routes built in EXP and enter the equipment condition(s) in their handheld inspection devices. Responsible to provide feedback to the equipment specialists as needed to improve the quality of the indicators and routes.
- Lead Planner/Scheduler (1 position) – Responsible for planning and scheduling proactive inspection and corrective activities to address non-normal equipment conditions. This role is critical to the weekly downturn planning/scheduling activities which now incorporate much more proactive work.
- Planner (2 positions) – Responsible for the detailed planning of inspection and corrective maintenance jobs within the Tabware CMMS. This includes the identification of all parts, materials, manpower, procedures, safety information, permits, tools, etc required to perform corrective maintenance work efficiently, effectively and safely.
- Operator (1 position) – Responsible to perform operator inspections of equipment and provide operator input to the work identification analyses.

Asset Risk Prioritization

To determine the order in which production equipment would undergo work identification, an Asset Prioritization analysis was conducted using Ivara EXP on the Finishing Mill systems within the HSM. The output of this analysis is a relative risk number assigned to each system identified. The relative risk number is the sum of the magnitude of consequences of failure of the system in terms of a number of criteria (including safety, environment, quality, throughput, cost and customer service) multiplied by the likelihood of failure of the system. The relative risk list, sorted in descending order in EXP, was used as a starting point for the WCER team to develop their work identification plan for the HSM. However, relative risk was not the only parameter considered in the development of the work identification analysis plan.

Efficiencies Using Ivara EXP Smart Copy

Another key factor used in determining the sequence of analyses was the potential that an analysis had to be applied to multiple assets. The team identified those systems that were similar to others within the HSM as these offered the opportunity to fast track both the analyses and their implementation through the use of templates and the Smart copy capability within Ivara EXP. In this manner, failure modes and the associated action plans developed through formal work identification analysis for one asset are copied to another asset, taking along all the detail of the indicator(s) built to inspect for asset condition and the corrective task required when the indicator condition is found to be non-normal. A validation of these failure modes, condition indicators and tasks is performed with equipment operators and maintainers prior to making them active to ensure that they do in fact apply in the operating context of the new asset. The use of this software functionality allowed for rapid implementation and deployment of technically based maintenance programs for the like type systems within the Finishing Mill. Their strategy to employ templates and analysis copying enabled the HSM-WCER team to rapidly implement 11,236 indicators within 12 months.

Work Identification

AM-USA WCER leadership identified 4 options to be used for formal work identification, including Aladon Reliability Centered Maintenance (RCM), Aladon Maintenance Task Analysis (MTA), Current Inspection Implementation (CII), and RCFA. These approaches vary in their level of rigor from the very detailed analysis of RCM to the less rigorous approach of CII. The approach selected depends on a number of factors including the complexity and criticality of the equipment, availability of knowledgeable resources, current and targeted performance of the equipment and the

current level of knowledge of the equipment operation and its performance. The BH-HSM leadership chose to employ only MTA and RCM for all of their analyses. Key reasons for this decision included:

1. Thorough program documentation was identified as a requirement of the effort.
2. Sufficient resources available to support all elements of work identification performance and implementation.
3. They are strong supporters of technically valid work identification techniques.
4. MTA specifically offered the potential for rapid program implementation within Ivara EXP and therefore rapid deployment of the improved proactive inspection activities.

Work identification analyses were conducted with the participation of trades and operating personnel from the Finishing Mill area. Once analyses were completed, the results were compiled into Summary Reports for review and approval by the area management team.

Implementing Maintenance Action Plans

Following approval, equipment specialists implemented the action plans through the creation of indicators within Ivara EXP. An indicator is defined as a point of inspection for an asset which highlights whether or not a specific failure mode is developing which could potentially lead to a subsequent asset failure. The indicators were organized into logical groupings called routes which are all of the indicators to be inspected by a specific role at a specific frequency for a given asset operating condition. New routes are validated by the implementer working with an inspector to complete the route to identify any changes to indicators or their sequencing which would improve inspection quality and effectiveness. Once validated, the routes are activated and data collection and analysis commences.

The 11,236 indicators implemented to date have been organized into 386 separate inspection routes for operating and maintenance personnel. Of these routes, 45 percent are performed while the equipment is running while the balance must be done during a shutdown.

With use of the Ivara EXP Asset Health Indicator Panel, the team was enabled to manage equipment problems by exception since the software consolidated all sources of condition data, analyzed the data based on rules and calculations and provided one central view of the health of assets. Those responsible for an area are alerted when a problem arises, based on the condition data input from various sources.

Use of Predictive Technologies

The HSM WCER team aimed to maximize the effectiveness of their reliability program through the use of predictive technologies for asset inspection wherever possible and practical. This has resulted in the extensive use of vibration, thermographic, ultrasonic and oil analysis techniques throughout the program. Predictive technologies have already proven highly successful in identifying non-normal asset conditions for follow up.

In order to monitor how effectively the WCER business process is executed, the HSM WCER team built KPI dashboards within Ivara EXP to track and report on all aspects of WCER including strategy development, program implementation, performance management and work management. This information provides personnel involved in WCER the means to quickly see how well they are executing their business process activities and highlights any issues well before they negatively impact equipment performance.

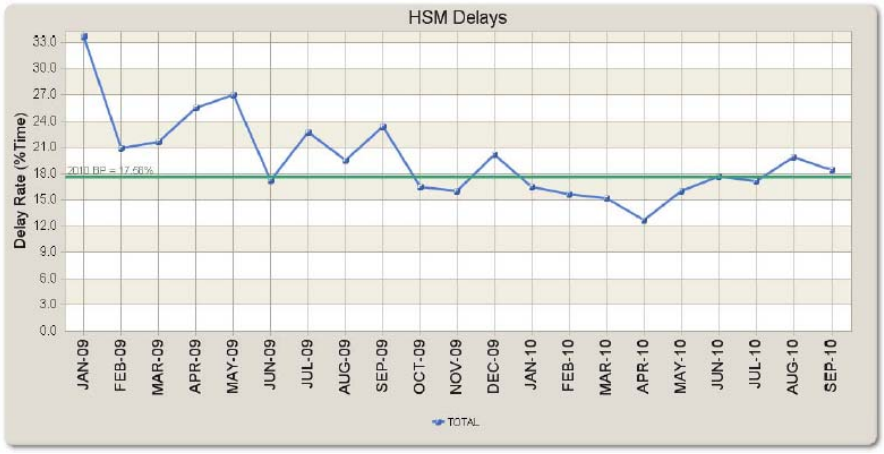
Results:

Over a period of 12 months since the launch of the WCER program in the Burns Harbor Hot Strip Mill, a total savings of $2.1 million has been realized. These savings have come from several areas including:

- Avoidance of unplanned downtime of production assets through equipment inspections aimed at identifying potential failure conditions and through the modification of production equipment to eliminate specific failure modes. The non-normal conditions were addressed with appropriate corrective action prior to failure. These improvements resulted in a savings of $1,282,500 due to avoided equipment failure.

- Improved efficiency of corrective work performed during scheduled Plant shutdowns due to information provided from equipment inspections coupled with improved planning and scheduling practices. Schedule compliance for shutdowns has increased from 65 to 80 percent resulting in a manpower savings of $394,400 on an annual basis.

- An improvement in HSM work ratio due to reduced asset downtime that translates to a savings in energy (gas/electric) consumption of $400,000.



Improvement in Burns Harbor Hot Strip Mill Delays

Significant Costs Avoided – Some Examples:

Some specific examples of unplanned downtime of production equipment that was avoided through the identification and correction of non-normal equipment conditions or redesign of the equipment are:

Single Modification Saves $200,000 Per Year by Avoiding Unnecessary Bearing Failures

During the analysis of the finishing mill stand #1 (F1), it was identified that bearings failed on average twice per year at a cost of $100,000 per bearing. These failures were determined to be caused by problems with the lubrication hoses. The analysis team recommended that the hoses be re-designed in a manner that eliminated this cause of

bearing failure. This re-design has been completed and no bearing failures have occurred since the change. This single modification saves $200,000 per year by avoiding unnecessary bearing failures.

Vibration inspection of Finishing Mill #6

High vibration readings discovered in main gearbox.

A vibration inspection of Finishing Mill #6 main gearbox was identified through formal analysis and implemented on this equipment. Routine performance of the inspection highlighted a high vibration condition of the gearbox.

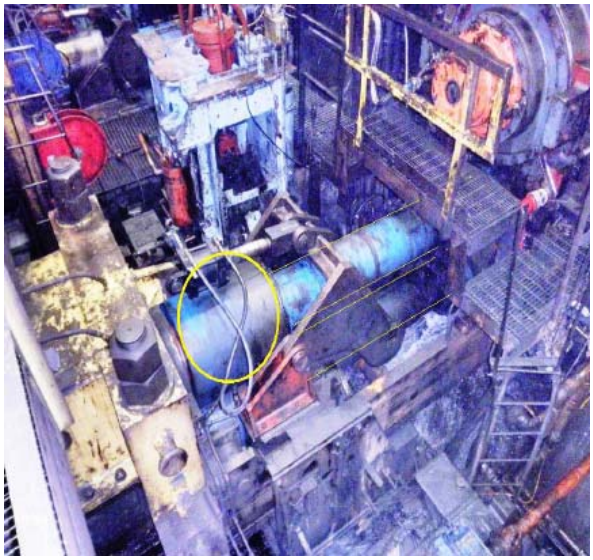
Further investigation triggered by this non-normal vibration reading identified the likely cause to be a lack of coupling lubrication. The coupling was properly lubricated and another vibration reading taken which was found to be normal.

If the coupling had failed, the corrective action would be to change the set of main drive reduction gears on which the coupling is press fit. The cost to recondition the gear set and coupling is $385,000 which is the cost avoided due to taking corrective action when this non-normal condition was detected.

Infrared thermographic inspection

An infrared thermographic inspection of the main drive spindles on the finishing mills showed the temperature of four (4) of the spindles to be excessively high. Investigation revealed that grease fittings on these spindles were failed and, as a result proper lubrication was not being supplied. On the next shutdown, the grease fittings were changed and the spindles greased. Subsequent IR inspection showed the spindles to be running at normal operating temperatures. Each unexpected spindle failure would have cost $120,000 and therefore detecting and correcting this non-normal temperature on 4 units represents an avoided cost of $480,000.

A lubrication oil analysis task was identified for the Ram Gear box on each finishing stand. On the first inspection, 3 of the 7 gear boxes were found to have extremely low oil levels triggering critical alarms in Ivara EXP. The gearboxes were drained and re-filled with lubricating oil. A failure of any one of these gearboxes would cost $38,000 and therefore this inspection finding represents an avoided cost of $114,000.



Mechanical Inspections: High average temperatures were discovered using an infrared camera.

Effective Use of Manpower During Weekly Scheduled Shutdowns

The HSM WCER effort has also driven a significant improvement in effective use of manpower during weekly scheduled shutdowns. In the past, shutdown work schedule compliance averaged only 65 percent due to the large amount of work identified during the shutdown. Much of this work was found to be critical enough that it had to be addressed before returning the mill to operation. This meant that some of the planned and scheduled work was delayed to a later time. The manpower applied to the newly found work was not efficiently used because the work they were performing was not planned in advance. Much of their time was spent searching out parts and tools to complete the jobs.

Equipment inspections developed and implemented through WCER have ensured that more of the critical corrective work is identified in advance, allowing the jobs to be fully planned and scheduled prior to the shutdown. The manpower available on shutdowns is now more efficiently utilized on planned activities and the work schedule compliance for shutdowns is now 80 percent every week. This increase in the efficiency of shutdown manpower utilization translates to a savings of $11,600 per shutdown or $394,400 on an annual basis.

The average production equipment delay rate in the HSM in 2008 and 2009 was over 20 percent, with 2009 averaging 22 percent delay rate or 78 percent working ratio. Since starting the WCER in the HSM, the average delay rate for 2010 has dropped to 18 percent which is a working ratio of 82 percent. Though this improvement has not translated into additional profit at this point in time due to the current economic conditions, it has resulted in significant energy savings (gas/electric only) in the amount of $400,000 year to date. Once economic conditions improve and markets return, the increased working ratio will deliver a significantly higher profit to the organization through increased production capability.

Additional Benefits

Additional benefits of the Burns Harbor HSM WCER effort which cannot be quantified in terms of cost savings include:

- Increased focus on effective planning of shutdown corrective work , resulted in improved safety for work crews.
- In order to perform more effective inspections, the WCER team has focused on cleaning up the entire finishing mill area. This has improved working conditions for area personnel and, in turn has improved worker safety.
- With the exception of 1 position that was filled from outside, the entire WCER team was formed from existing HSM personnel without increasing the labor budget. Therefore, this improvement effort came at little additional cost to the business unit and yet has already delivered a significant savings.

Future Direction

As a result of the improvements made in the Finishing Mill area of the HSM, the WCER team has now been mandated to implement a proactive maintenance program for the run out table and coiler area. Additional resources will be needed for this work and they will be drawn from the existing HSM workforce. With this increased scope of work, the WCER team is now responsible for the reliability program for 50% of all of the HSM assets. The team will continue their work in the same manner until all HSM assets have been addressed. It is clear that by taking a very focused approach to reliability improvement, providing team members with the essential skills, tools and information to be effective and looking for opportunities to fully leverage all of the work done, the WCER team at the Burns Harbor Hot Strip Mill have achieved very dramatic results in a 1 year period.

For more information, call 1-877-746-3787 or visit us at www.ivara.com.