Increasing manufacturing capacity through OEE improvements

Faced with increasing demand, CNH plant management had a choice. It could either make large investments in new plant equipment or it could explore capacity opportunities with existing production equipment. In an ideal world, a manufacturing facility operates its equipment 100 percent of the time at 100 percent efficiency with 100 percent quality product. In reality, these facilities can waste up to 40 percent of their manufacturing production capacity through unplanned stops and interruptions, speed losses, and quality defects. Normally, increased capacity demands are addressed through new equipment capital expenditures, but the hidden plant provides many opportunities through improved performance. This paper describes how CNH was able to offset new equipment capital expenditures by improving the performance of its existing equipment.

Determining performance

The CNH facility, located in Antwerp, Belgium, produces and assembles the high technology components of transmissions, rear axles, and jacks required by tractor assembly plants. These assembled components are shipped in the form of a transmission to its UK Basildon facility.

Several years ago, CNH recognized a growing demand for product. Wanting to optimize their capital investments, plant management looked to determine the performance of its existing equipment. Overall Equipment Effectiveness (OEE) is a Key Performance Indicator (KPI) of how equipment, production lines or processes are performing in terms of availability, speed (performance), and quality. The overall performance of a machine, production line, or entire facility is governed by the cumulative effect of these three categories. OEE loss types are defined in Figure 1. The OEE combines these three loss categories into a single measure of performance. It shows how well a company is using its resources, including equipment, labor, and the ability to produce quality products.

Requiring OEE measurements in Real Time

CNH has used OEE to measure performance for several years. Breakdowns, listed by team, were manually recorded on a spreadsheet and summarized weekly. The operator made a list of all disturbances, breakdowns, and conversion times. Each quarter, the data was distributed in the form of pie charts and made available for analysis. Although the manual system provided insight to plant performance, CNH recognized it had significant shortcomings.

First, data reliability was always an issue. Depending on when the data was collected and by whom, some OEE information was lost, for example, when machine micro-stops go unrecorded. Unfortunately, it is often the small incidents that
generate the greatest losses. Therefore, inherent process losses might go undetected.

Timeliness of the reports was another issue. CNH wanted to react to problems immediately; however, this was impossible with their manual system. Reports were published at the end of the week and quarter, long after the actual events had occurred. Consequently, if they were to maximize their installed equipment capacity opportunities, CNH needed a real-time OEE measurement and reporting system.

**ABB’s Real Time Production Intelligence is selected**

CNH selected ABB’s Real Time Production Intelligence (Real-TPI) for its enhanced OEE program. Real-TPI is a real-time performance measurement and analysis software program that improves plant productivity by identifying ways to increase OEE. Real-TPI automates the data collection and analysis, and provides customized reports tailored to the needs of the plant. The software harnesses the analytical power of three standard production evaluation processes:

- OEE
- Root Cause Analysis (RCA)
- Total Productive Maintenance (TPM)

When OEE indicates poor plant performance, RCA is used to determine what the problem is and where it is located so the corrective action can be taken. TPM is a process to adjust production equipment procedures with the aim of improving efficiency.

One of the biggest advantages of Real-TPI is to reduce operator workload. Real-TPI automatically records the end of one cycle and the start of the next. It also records processing speed, as well as identifies the operator and/or maintenance team with a specific machine. Breakdowns are transmitted from the PLC and consigned for later analysis. Operators can scan additional breakdown reasons using bar codes. In this way, various stop causes can be quickly and consistently inserted into the system to provide real-time awareness of a machine status (Figure 2). The software makes it possible to carry out a time analysis of the stop cause information. The result: Real-TPI reports the information to the people who need it, when they need it, and in the form in which they need it.

For CNH, Real-TPI provided another advantage. The flexibility of the Real-TPI system allowed CNH to configure their system to match the existing, manual OEE program philosophy. Hence, CNH was not required to abandon their experience gained over the years for the sake of the software. Real-TPI was merely a tool to enable CNH to carry on with these field proven practices more efficiently. In fact, CNH believed that by completing initial OEE work without Real-TPI, they became acutely aware of their ultimate objectives and how to achieve them with an automated system.

**OEE program quickly expands**

Initially, Real-TPI was implemented as a test pilot on three CNC machines. The one-month study was used to demonstrate the capabilities and benefits of the software. Real-TPI compared actual machine productivity with supplier recommended levels, and when sub par performance was detected, Real-TPI identified where production losses could be limited. Classifying losses as breakdown losses (i.e. disturbances, conversions, breakdowns), speed losses (i.e. when two machines are operated by the same operator
and simultaneously finish their cycle), and quality losses (i.e. rejected products), the first results clearly slowed the wasted time between the end of one task and the beginning of the next one and the additional time spent on each step.

Real-TPI analysis and reporting tools are used to identify typical problem types, when and where they occur, and what impact they have on overall OEE. This is where the Real-TPI product provided its greatest value. The results provided the plant management team an excellent view of the availability, performance, and quality factors per order, per product, per shift, or other specific periods of time. With these analysis screens, production managers could focus on the 20 percent of the production failures that typically represent 80 percent of the production losses (Figure 3).

From the information gathered on the one-month study, the project quickly expanded during the next two months to an additional 13 CNC machines and two washers. In the beginning, CNH estimated that an additional 15 CNC machines would be required to meet the new demand. After the implementation of Real-TPI, it was determined the existing machines could meet the capacity requirements of five new machines. Therefore, CNH could minimize its new purchases to ten machines.

**Continuous analysis leads to intelligent TPM**

The path to the ideal manufacturing facility is a process of continuous OEE process measurements, root cause analysis, then creating the strategies for production equipment improvements. At CNH, the next phase of this process resulted in tool reporting improvements.

The Real-TPI time analysis of stop causes identified tool replacement as a major contributor to production losses. This significant machine downtime time could be broken down to the following events:

- Notification of new tool requirements to the tool crib.
- New tool delivery to the machine.
- Installation of the new tool.

The new TPM procedures implemented by CNH synchronized tool conditions of the CNC machines with the tool crib via Real-TPI. When Real-TPI detects an early stage tool problem, it automatically notifies the tool crib via the plant network. The automatic message includes time stamp, tool number, priority, and machine number. A manual request option was developed as well.
These procedures streamlined the tool replacement procedures and resulted in tool delivery and replacement before the actual tool breakdown occurs, resulting in significantly lower machine downtimes (Figure 4).

**Summary**

From the initial integration of ABB’s Real Time Production Intelligence, CNH has met new demand by improving performance of the existing plant. Real-time collection and analysis of process data via Real-TPI provided productivity improvements and a better understanding of production line needs. Currently, CNH has installed Real-TPI on 25 CNC machines and two washers with plans to expand to the entire CNC farm. Through consistent, real-time measurement, analysis, and improvement of the Key Performance Indicator OEE, CNH can determine the true performance of its manufacturing facilities and identify ways to improve them; achieving a sustainable, competitive advantage in its marketplace by performing smarter and better at substantial cost savings.

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