Lessons Learned On How to Increase OEE Performance

IQMS®
Manufacturing ERP

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- A leading industrial goods manufacturer was able to reduce scrap rates by 27% over four months by standardizing on Overall Equipment Effectiveness (OEE) as their primary manufacturing measure of performance.

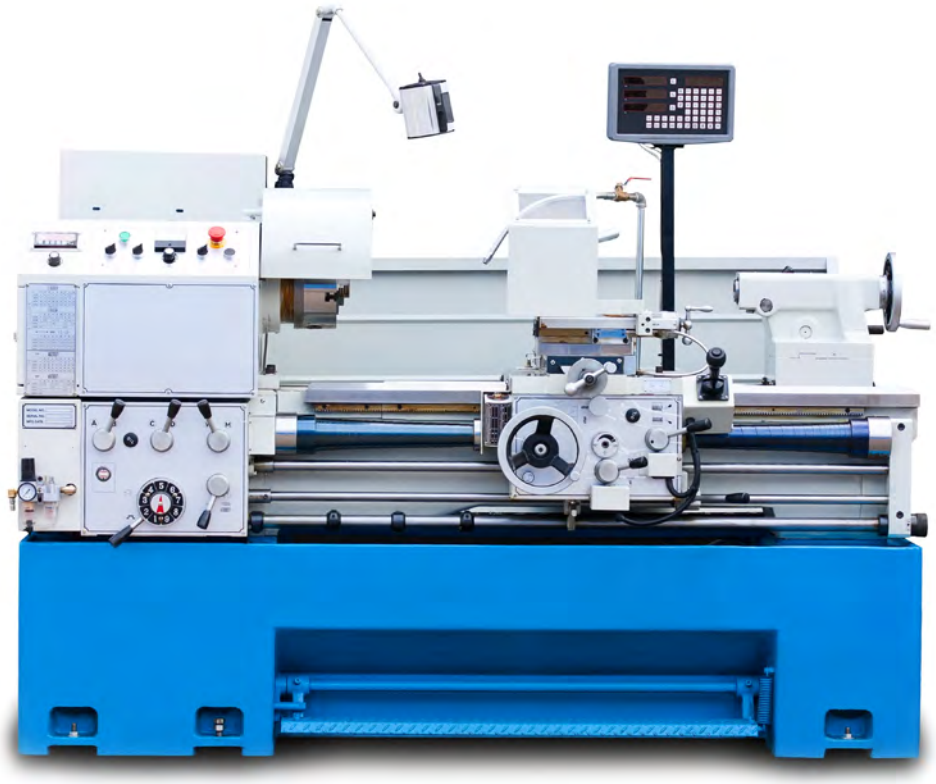
- An injection molding manufacturer was able to increase OEE performance by 7% in three months, increasing gross profit by $1.2M across six production plants globally.

- Attaining an OEE score in the 80 to 85% range is widely considered to reflect a world-class manufacturing operation.

- OEE is calculated by multiplying the (%) of time manufacturing machinery is available by production performance (ideal cycle time x total count/runtime and product quality (Good Count/Total Count).

Overall Equipment Effectiveness (OEE) continues to gain in popularity as manufacturers seek to quantify plant, manufacturing line, and machine-level performance, finding ways each area can be improved. Lean manufacturing and total productive maintenance (TPM) are the foundations of OEE and are contributing to its growth today. By providing valuable data to manufacturers at the machine, assembly line and plant level, they can produce the highest quality products at the lowest cost within the challenging constraints of short lead times. OEE and comparable manufacturing metrics are also fueling the development of advanced analytics and business intelligence (BI)-based software that includes the next generation of Manufacturing Intelligence applications.

At the same time, it is important to step back from all the intensity, hype and urgency surrounding OEE and set expectations as to what this metric can and can't do. Many times, OEE slows down production and causes companies to be less customer-centric and lean. As useful as OEE is as a metric, it can mask bigger and more potentially more challenging manufacturing problems if not used in the right context. In particular, too much reliance on OEE can hide manufacturing performance gaps at the machine, production line, and plant or factory level. The goal of this e-book is to provide insights on how manufacturers can improve OEE performance.



Where To Start

The majority of manufacturers begin using the Overall Equipment Effectiveness (OEE) metric to establish a performance baseline for specific machinery and production assets. Taking this baseline-driven approach at the machine level enables manufacturers to scale the OEE metric across manufacturing units, production lines, and eventually production centers.

Manufacturers who are attaining OEE scores in the 80% range and higher, combining insights gained from OEE with additional manufacturing metrics to improve production performance. The highest performing manufacturers realize that OEE's greatest value comes from its ability to help stabilize production and establish accurate baselines of performance. OEE excels at quantifying availability, performance, and quality for machines and assets, enabling comparisons across production centers.

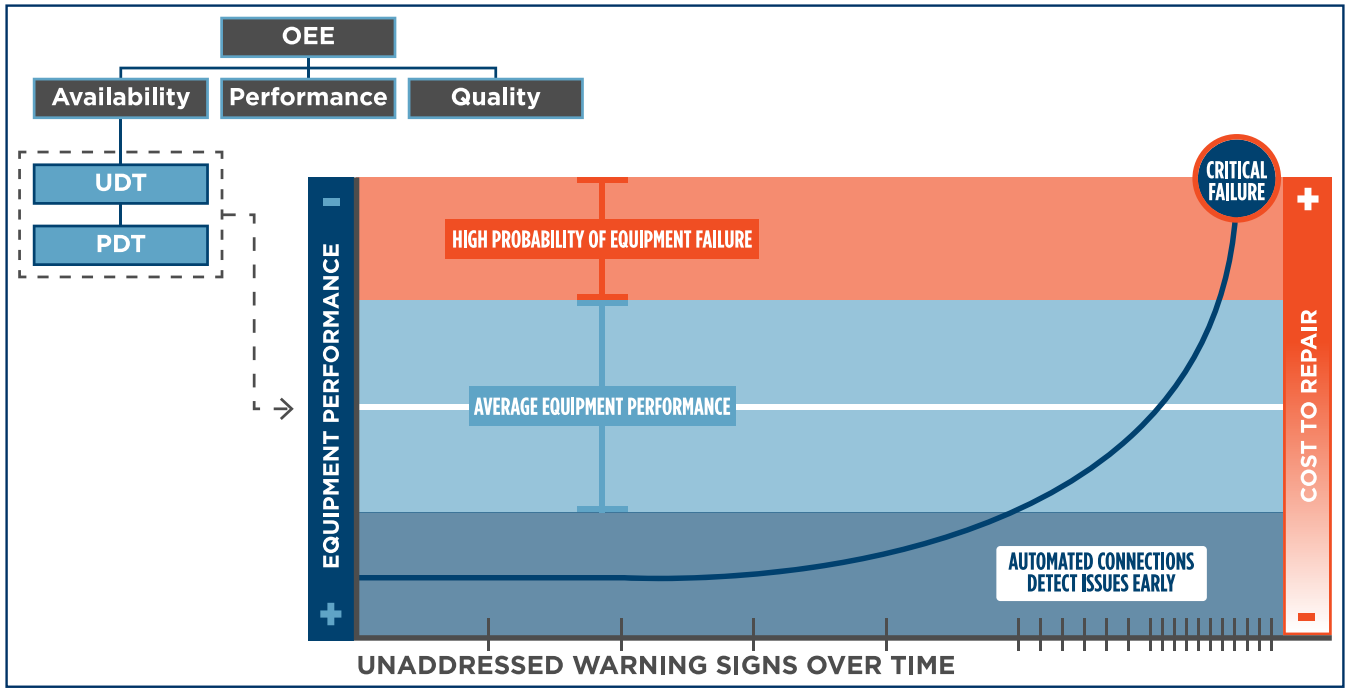
OEE is calculated by multiplying machine Availability by Performance by Quality. Starting with Availability, unplanned downtimes (UDT) and planned downtimes (PDT) are subtracted from the total potential production time to provide the Run Time Availability. Total Availability is then calculated by dividing Run Time by Planned Production Time.

OEE's Performance component is defined as the difference between the theoretical maximum output a given machine is capable of compared with actual output. Actual output is derived by subtracting out minor stoppages, reduced speed and any other factor that reduces the performance levels of a given machine or asset. Performance is defined as the Ideal Cycle Time multiplied by the Total Count divided by the Run Time. Performance is also defined as the Total Production Count divided by the Run Time, divided by the ideal Run Rate.

Quantifying quality is a valuable component of any OEE measurement, unifying the measures of Availability and Performance from the customer's perspective. Quality is the one undeniable measure of how well OEE is being managed from the machine, product line and plan level. Comparing the actual output to good product yields net of scrap and rework is how Quality is measured as part of the OEE metric. In discrete manufacturing operations, OEE quality resembles First Pass Yield. Like yield metrics, OEE quality measures the number of good parts successfully produced in a specific timeframe. Quality is calculated by taking the good product count divided by the total product count produced.

The diagram below illustrates how OEE can be combined with real-time monitoring to track and report on early signals of equipment malfunction, averting costly shutdowns. The scenario shown below is why OEE is rapidly gaining adoption in manufacturing for monitoring the stability and reliability of machinery. Manufacturers are also relying on OEE to predict when specific machinery will need preventative maintenance.

OEE Brings Greater Stability To Production
And Greater Machine-Level Preventative Maintenance Insights



Roadmap To Increasing OEE Performance

OEE has the potential to revolutionize manufacturing from the shop floor to the top floor. The most successful OEE strategies begin based on organizational goals that impact every aspect of a manufacturer's business. OEE is most often contributing to the strategic goals of improving quality, decreasing costs, improving productivity and increasing capacity.

Every manufacturer's roadmap to increasing OEE performance is going to vary based on their unique supply chains, production processes, product lifecycles and extent of manufacturing data to the machine level. The roadmap of how to improve Overall Equipment Effectiveness (OEE) is a framework that all manufacturers can use to get the most value out of OEE possible.

In using the roadmap below it's important to keep in mind the following regarding how improving OEE performance increases production quality, efficiency and contributes to increasing revenues and profits:

- **OEE is one of the best manufacturing metrics for stabilizing the production levels of a given machine or asset.** Consider scaling OEE across an entire production line after pilot tests with specific machines are complete. Comparing lines using OEE provides an accurate baseline of machines and their capacity to improve.

- **Include OEE measurements by machine in quality management dashboards and reports to gain insights into how machine yields, scrap rates and reject rates are impacting Cost of Quality (CoQ) and acceptance rates.** OEE's first contributions will be to stabilize production levels by machine or asset across the shop and plant floors. By combining OEE with other metrics, it's possible to quantify manufacturing reliability. Using the roadmap below manufacturers can transition OEE from being a metric used to stabilize manufacturing machinery for quantifying plant-level manufacturing reliability.

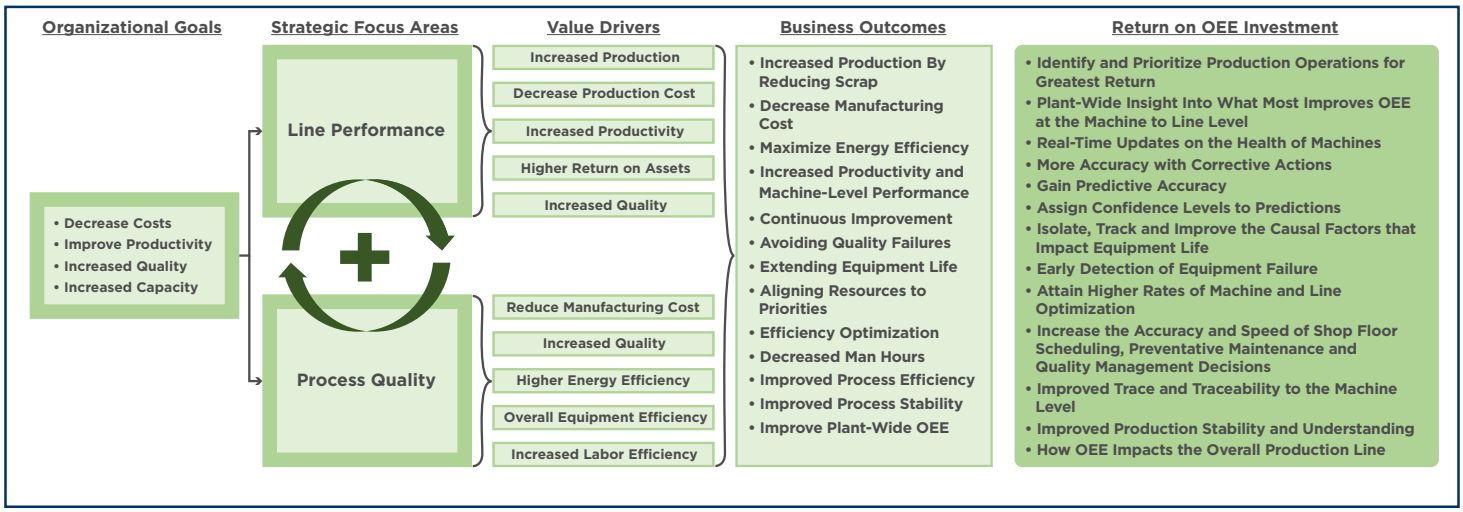
- **The most effective OEE strategies are intentionally created to support long-term organizational or strategic goals, focused on improving line performance and process quality.** OEE is a great stabilizing metric in manufacturing in the short-term. Long-term goals need to be measuring the reliability of the entire manufacturing process, tying performance back to business outcomes and return on OEE investments. World-class manufacturers are using real-time monitoring to track OEE to the machine level while gaining new insights into manufacturing's contribution to cost reductions, improved productivity, quality, and increased capacity.

- **Scaling OEE to improve production line performance forces process quality to also improve.** When a production operation transitions from using OEE as a manufacturing stability metric for predicting manufacturing performance, plant floor processes improve. This is driven by the greater insights gained into how each machine's performance on a production line can be improved with less complex, more scalable processes across the production floor.

- **Tying line performance and process quality gains to business outcomes fuels OEE performance gains.** The key to accelerating OEE performance is tie back improvements to business gains and outcomes. When a solid connection is made between improving OEE performance and seeing improved business outcomes, cost and revenue goals are achieved quickly. The key to improving seeing OEE performance payoff is knowing how each incremental gain by machine, line, and plant improve revenues and reduce costs.

The following graphic provides an overview of IQMS' roadmap of how to improve Overall Equipment Effectiveness (OEE), illustrating how all steps need to lead to business outcomes and delivering a solid return on investment.

Roadmap of How to Improve Overall Equipment Effectiveness



Lessons Learned From Improving OEE Performance

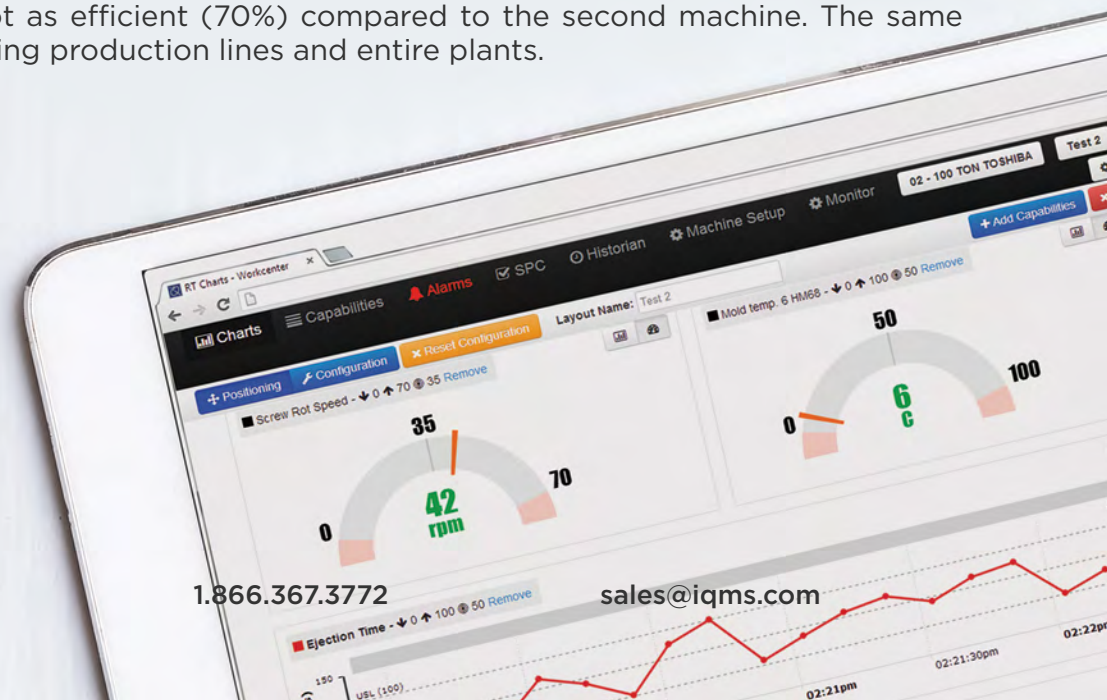
Keeping revenue growing and costs under control is the fuel that keeps a manufacturer strong. Knowing how effective each machine is in meeting production goals by tracking availability, performance, and quality is the essence of OEE.

The following are the lessons learned from manufacturers who have successfully integrated OEE into their daily operations:

- **Use OEE to reduce downtime losses by stabilizing all machines on the shop floor during the pilot phase.** Tracking and analyzing, in real-time, if a given machine on the shop floor is about to break, factoring in equipment set-up times, and unplanned and planned downtimes are just a few of the many ways OEE is making an immediate impact on manufacturing performance. Consider how an initial OEE pilot can capture and provide data as to which production machines need immediate attention to reduce and eliminate downtime losses.

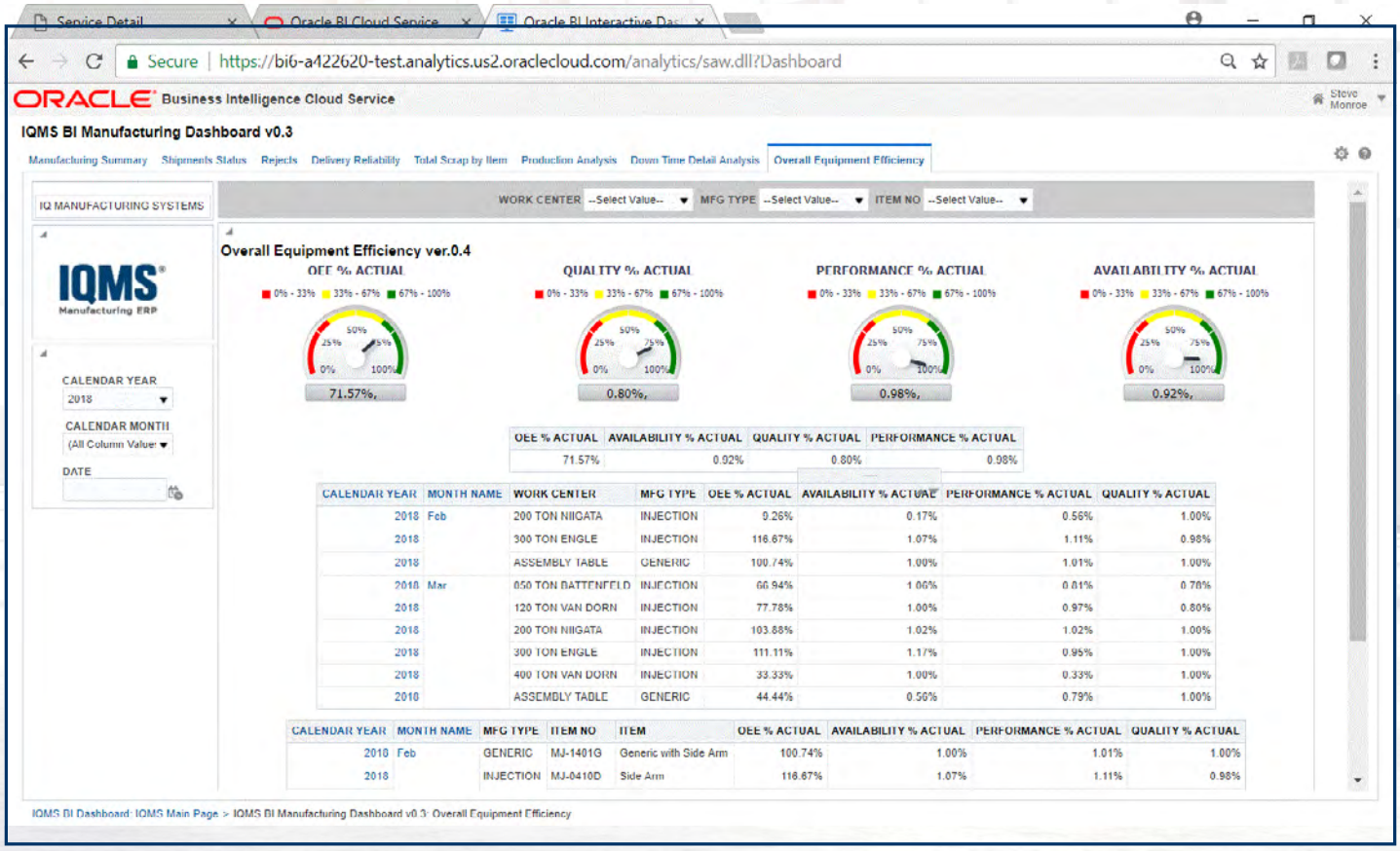
- **Set the goal of creating trusted, scalable datasets that accurately reflect 100% of all machine activity and states of operation.** Be sure to guard against OEE measurements becoming biased or too politicized. OEE has started to be included in manufacturing, quality and production teams' compensation and bonus plans. With annual reviews, quarterly and year-end compensation, and bonuses riding on OEE levels, manufacturers are practically asking for the data to be skewed. While achieving high OEE scores is important, it is far more important to have a trustworthy, credible process for arriving at OEE that scales across the company. Consider de-linking OEE from salary increases and bonuses and redefining how it is measured to ensure the data produced is accurate and can be trusted.

- **When comparing aggregate OEE metrics between one production line to another factor-in the individual machine first pass yields, scrap rates, and run times.** There's an exponential increase in the number of manufacturers who are using OEE to compare production line performance. Many are using aggregate product line metrics at the top of their dashboards and scorecards, and also have drill-down metrics to the machine level all on one screen. Enabling production and quality management teams to drill down into OEE calculations and seeing the mix of availability, efficiency and quality metrics is invaluable. Having drill-down data available helps to troubleshoot individual problems quickly that may be hidden behind a single aggregate OEE metric. Comparing machines with two identical OEEs doesn't ensure accuracy. One could have 70%x90%x80% and the second could have 90%x70%x80%. Both have the same OEE, yet one has limited availability (70%) while the second is not as efficient (70%) compared to the second machine. The same logic holds for comparing production lines and entire plants.



- **Factor out equipment setup times from OEE measurements.** Reducing overall equipment setup times has a direct impact on Availability, further artificially inflating OEE performance. Equipment setup times often skew value stream-based production scenario calculations, so it's a good idea to also factor them into any process re-engineering projects across the shop floor. Initiating a time series analysis of setup times in conjunction with OEE measurements provides insights into how Availability can be improved quickly. One extrusion molding manufacturer is tracking setup times for their largest machinery and working to reduce them, indexing gains in OEE as a result. It's working, and OEE is improving, also, to yield rates for their largest, most expensive machines to operate.

- **Consolidate OEE measurements on a single dashboard, enabling real-time monitoring to accelerate machine, production line, and plant performance gains.** Every machine operates at a unique cadence with its variations in the key components of Availability, Performance, and Quality. By having real-time data from every machine in a production line, heads-up displays like the one shown below are being used across production floors today. This specific dashboard reflects OEE performance across work centers, breaking out Availability, Performance and Quality components. This specific view of the dashboard shown below also reflects time series results by the calendar year and month, which is invaluable for finding trends in each OEE component's value over time.



Conclusion

Stabilizing machinery performance is the factor that drives the majority of manufacturers first to adopt OEE. As individual machines and production lines stabilize, OEE reflects manufacturing reliability.

For all of its contributions to improving manufacturing performance, it's not meant to be used as a single, end-all metric of manufacturing performance. Instead, it's best to group OEE into a dashboard of metrics that expand on visibility into Availability, Performance, and Quality at a deeper dimension than the structure of the OEE metrics allows for on its own. OEE has the potential to revolutionize production operations taken in the context of overall manufacturing performance.

Bottom Line: OEE delivers insights at the machine, production line and plant level that have not been available before to many manufacturers. Knowing how Availability, Performance, and Quality impact the most financially important areas of their business including time-to-customer, order cycle times, perfect order performance and meeting customer ship dates can revolutionize how manufacturers meet and exceed customer-driven goals for their business.