Transforming Operational Excellence

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A digitally empowered performance management approach helps manufacturers identify key operational bottlenecks and directly tie improvements to bottom line business impact.

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For decades, manufacturers have pursued continuous improvement as a critical means to reduce costs, increase revenues, and achieve competitive differentiation. The focus on operational excellence, meanwhile, has cut out process inefficiencies and increased flexibility and performance. In parallel, almost 70% of manufacturers accelerated their digital transformation initiatives in the face of the pandemic, investing in Industry 4.0 technologies that incorporate data and analytics, augmented reality, and machine-to-human interfaces.

What is surprising, however, is that while the pace of digital technology adoption is now at an historical high and growing exponentially, when it comes to continuous improvement and operational excellence, the enabling processes are still mostly manual and analog in nature.

Even with the increased adoption of Industry 4.0, several challenges have prevented digital solutions from effectively transforming operational excellence.

First, most companies report they remain data rich, but insight poor. Very few companies have successfully unlocked their data to expose the necessary insights required to systematically identify, prioritize, and focus resources on the most critical production constraints.

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Secondly, there is a disconnect between front-line workers and management in terms of aligning to proactively analyze production losses. The systems and tools that management use to monitor performance are often disconnected from the tools and front-line data sources operators are using to execute production.

Third, the sheer number of variables now affecting production performance makes it practically impossible to uncover hidden patterns and develop corresponding corrective actions without holistic and accurate insights.

Fourth, it is difficult to track and trace the status of those corrective actions and measure their corresponding operational and financial impact.

As a result, with all the promise of Industry 4.0, few manufacturers today are leveraging advanced technologies in a manner necessary to achieve real transformational outcomes. When measuring the best demonstrated production cycle times or speeds, with high quality, best in class factories can operate at 85% capacity utilization. Yet the majority of manufacturers are still falling short of this performance level and are operating much closer to an average of 40-60% efficiency.

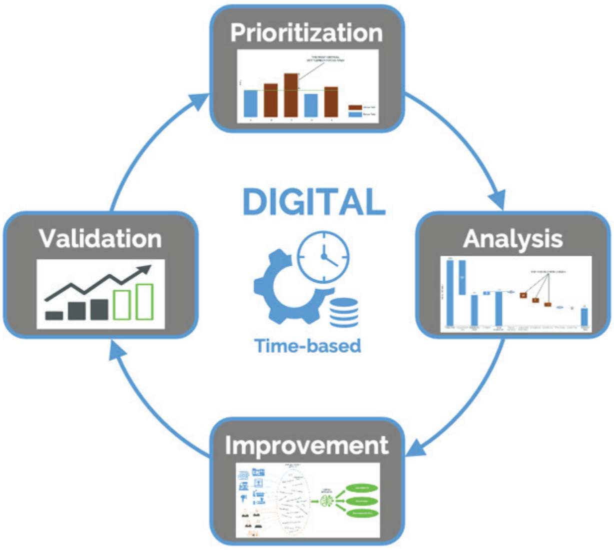

Figure 1: Digital Performance Management is a closed loop problem solving approach empowered by 4 digital capabilities. Source: PTC

However, by adopting a systematic closed-loop performance management approach known as Digital Performance Management (DPM), manufacturers can more easily identify, prioritize, analyze, and validate the absolute top opportunities for financial improvement. This best-practice approach, empowered by a combination of key digital technologies, ensures manufacturing resources at every level of the organization are always focused on the highest impact opportunities. It can also help manufacturers to overcome these four key transformational challenges while improving production efficiency by at least 5-20%.

Problem Identification and Prioritization

Several manufacturers are adopting digital technologies to improve their operations, yet most fail to determine where to best focus and prioritize their transformation efforts. The best practice is to prioritize the bottleneck, the most constrained process in a value chain of processes, because its limited capacity reduces the capacity of the entire value chain.

While standard factory KPIs like OEE can indicate directionally what problems are occurring, current OEE applications are frequently applied to non-bottleneck operations, leading to zero or minimal impact. It is only when the focus and resources are aimed at resolving true bottlenecks that production efficiency can be improved.

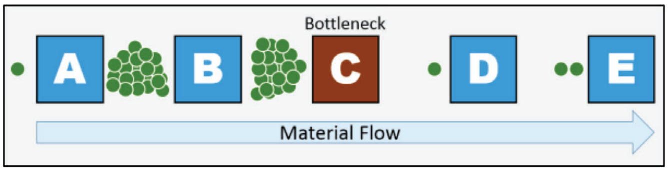

Figure 2: Only an improvement in the OEE of bottleneck process brings an improvement of the overall system.
Source: https://www.allaboutlean.com/use-oee/

For example, assume the system above with five processes (Figure 2), where process C is the bottleneck. If resources target OEE improvements at process A, throughput will not improve but inventory will accumulate on processes between A and C. Similarly, if resources focus on improving OEE at process E, improvements will not be captured because process E will always wait for parts from bottleneck C. Only an improvement in the OEE of the bottleneck at process C can unlock improvements to the efficiency of the end-to-end process.

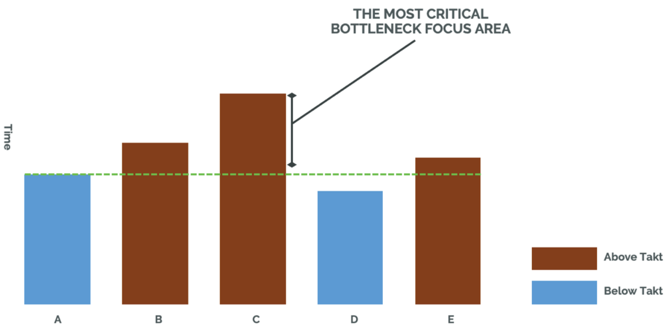

Figure 3: Automatic time study and bottleneck identification.
Source: PTC

Identifying bottlenecks, as well as their relative priority to one another, is often a highly manual and challenging process. Many times, factories will know their first bottleneck, but are uncertain of the second or the third, and have no visibility into the relative impact of each. With digital technologies, especially Industrial Internet of Things (IIoT), manufacturers can automatically collect and analyze the takt time and cycle time, dynamically identify priority bottlenecks across their work centers, lines, and factories even as bottlenecks evolve. This helps manufacturers always know where the biggest problems are, ensuring they are continuously solving the right problems at the right place and right time.

Root-Cause Analysis

It is often challenging to identify, analyze and prioritize top opportunities for eliminating production losses. While many manufactures turn to traditional tools like OEE reporting for this analysis, few have been able to confirm their desired throughput improvements for several reasons.

- First, when using today's most popular OEE metric of plant performance, manufacturers are limited to analyzing their operations through the secondary measurement of percentages, often in a non-standardized way. Each line, factory, or business unit may calculate OEE differently, using varying information. Operations leaders are not able to see or understand these differences as they are effectively hidden inside percentage-based numbers and ratios.
- Second, traditional OEE is typically deployed across every asset in a line, resulting in problem solving on assets that do not constrain the line, as noted above with bottlenecks. This creates a cycle of wasted resources trying to improve OEE asset by asset, without seeing measurable improvement in overall throughput.
- Third, the traditional OEE calculation of availability x performance x quality, typically does not collect data about, or measure, 100% of losses (i.e., changeovers, best demonstrated cycle times, small stops, labor related losses, or impact of speed loss). This means there are many hidden aspects that will never be uncovered because the data does not provide a comprehensive, or sufficiently detailed, insight for effective problem solving.
- Fourth, OEE excludes labor performance from the analysis and therefore, by its nature, is only a subset of the total performance algorithm. Labor performance often remains a manual process that is not factored into traditional OEE.

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As a result, front-line operators and managers are unable to clearly understand the magnitude of production losses throughout the value stream. What's more, valuable resources often pursue improvements on non-impactful processes, which translate to minimal or no impact results, and increase risk through a lack of prioritization about true production constraints.

With the advancement of technologies like IIoT and artificial intelligence, manufacturers can now gain a complete picture of both machine efficiency and labor productivity in real-time, or over a defined period. This complete picture enables manufactures to identify the most impactful opportunities by moving away from percentage-based measurement to the most well-known unit of measure – the common hour. Normalizing all performance losses to time rather than ratios of availability, performance, and quality, highlights the relative importance of different production losses and renders insights instantly actionable by everyone. This approach helps teams conduct a granular and consistent analysis that can be directly converted to financial impact. Operations leadership can instantly recognize the value of an hour, whether by increased revenue, reduced operating costs, or both.

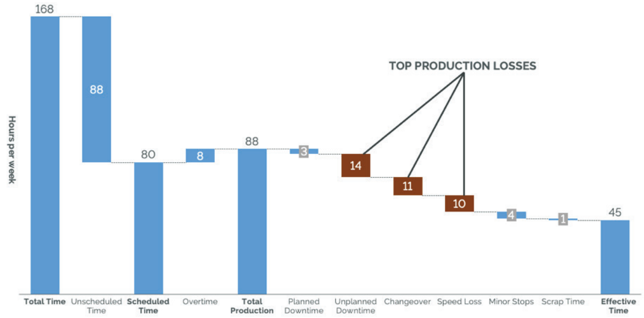

Figure 4: Time-based waterfall pinpoint top losses and root causes. Source: PTC

Improvement Actions

Once top priorities are identified, another common obstacle is determining the specific corrective actions that will improve efficiency. Fishbone diagrams and other techniques may provide tried and tested approaches to exploring these challenges but can be slow and resource intensive. If there is an incomplete understanding of the scenarios related to the identified loss area, the chosen improvement may not deliver the desired results. Furthermore, there are often hidden patterns in the data for every problem. To uncover these hidden patterns, process engineers must spend days and weeks manually analyzing data to determine a set of corrective actions.

By applying artificial intelligence to the always current, always accurate, dataset manufacturers can better identify patterns of production losses and perform multi-variable analysis on issues that occur during, before, and after loss events. This systematic approach provides continuous and prescriptive recommendations to the most likely opportunities to regain lost production hours. The manual process can now be accelerated significantly and completed in minutes, not weeks, allowing process engineers and plant managers to free up time for actual problem-solving and improvement actions, rather than wading through analysis and data-interpretation.

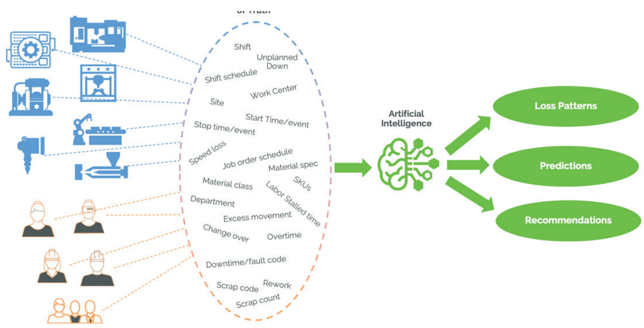

Figure 5: Prescriptive insights that recommend corrective actions for improvement based on time loss diagnostics and historical patterns of multiple variables. Source: PTC

Impact Validation

Manufacturers also struggle to track and trace the status of corrective actions and measure their corresponding operational and financial impact. While current approaches like traditional OEE can indicate performance trends, these conventional approaches fail to quantify how much a specific corrective action has improved overall performance. As a result, operators, improvement engineers, and plant managers have limited visibility in evaluating the success of their improvements. In the traditional approach, a company may set a target of 5% improvement, but because that improvement goal is not tied to measured gains in capacity and throughput, that 5% can rarely be taken to the bank.

By leveraging digital technologies like IIoT solutions, manufacturers can gain closed-loop traceability of corrective actions and the corresponding business impact. With this capability, continuous improvement teams, plant managers, and supervisors can define performance baselines and assign owners to continuous improvement actions and then measure progress using accurate data sourced directly from machines on the front line, which gives them the ability to correlate those improvements directly to financial impact.

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With this universal digital approach, management can set financial targets in hours rather than percentages and know precisely where they are in achieving that outcome. They can now predict: "I will improve by four hours and those new hours will be converted to additional volume resulting in $X additional revenue and margin, or perhaps $Y in overtime cost reduction". All resources can be united as an integral team and focused at solving issues towards a goal of X hours of improvement that will result in $Y financial benefit.

Transforming Operational Excellence

Digital technologies present a transformational opportunity for manufacturers to empower, accelerate, and reimagine the practice of operational excellence. A Digital Performance Management approach is at the epicenter of this transformation as it can collect and normalize production data to a standard metric of time loss and help operations management automatically identify bottlenecks, prioritize the most impactful improvement opportunities, drive closed-loop validation of business impact, and align all resources and all sites around a fully transparent standard approach to performance management.

Leading manufacturers who have adopted this best practice approach have already been able to validate 5-20% gains in improvement. There is now an opportunity for all manufacturers to leverage these digitally empowered approaches to help supercharge their operational excellence so they can finally harmonize the front line with the bottom line for the years ahead.

Based on analysis of benchmark data from the World Economic Forum, McKinsey, and PTC customers. Calculated against the best demonstrated rate.

About the Authors

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