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The Maintenance Advantage in Manufacturing

Achieving Excellence in Three Dimensions

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The Maintenance Advantage in Manufacturing

Achieving Excellence in Three Dimensions

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AT A GLANCE

Many manufacturers have historically taken a hands-off approach to maintenance labor, fearing they might alienate workers if they introduced new practices to improve productivity. But it's time to change this mindset. Improvements in maintenance productivity can enable 10 to 20 percent savings in costs for labor, parts, and utilities and unlock significant improvements in manufacturing productivity.

Improving Maintenance Productivity Is Challenging

Because there's no one-size-fits-all approach to improving maintenance productivity, manufacturers often struggle to prioritize and sequence improvement measures. It's especially challenging to assess maintenance productivity and effectiveness, identify root causes of problems, and make improvements. And a shift in mindset is often required to get skilled craftsmen to accept new ways of working.

A New Approach

The "maintenance advantage" approach allows manufacturers to understand the priority areas for improving maintenance productivity, how to implement improvements in these areas, and how to sustain improvements. The framework covers three dimensions—strategy, execution, and governance—and comprises 14 levers. Manufacturers can apply the framework in a four-phase process.

When seeking to improve productivity, many manufacturers have historically taken a hands-off approach to maintenance labor. Maintenance workers have been regarded as skilled craftsmen—and management has feared alienating them by introducing new standards, metrics, and practices to improve productivity. Manufacturers have also sought to keep maintenance staffing levels high to ensure that equipment breakdowns are addressed immediately. The savings from minimizing production downtime are thought to outweigh the costs of keeping excess capacity in the maintenance labor pool.

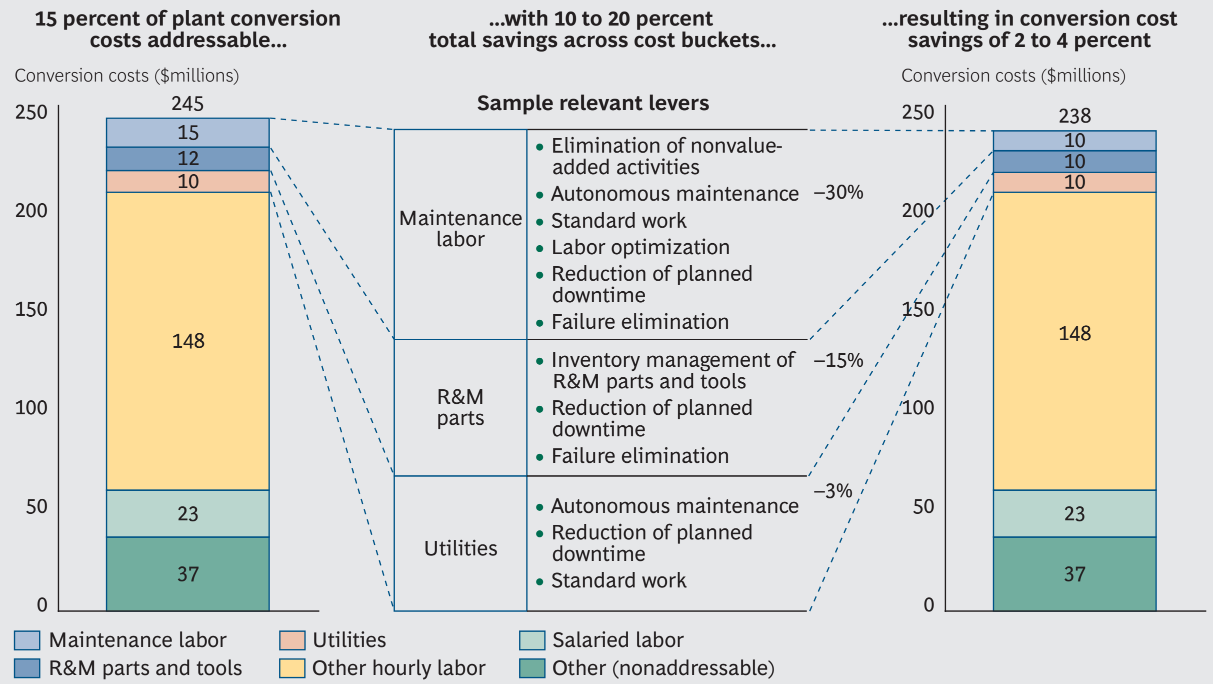
But this traditional mindset has come with a price. Manufacturers are missing out on opportunities to improve overall operating performance as well as reduce maintenance costs. Enabling the maintenance function to provide better service to production promotes better equipment performance. The resulting increase in uptime can lead to significant operating improvements. At a global steel manufacturer, the introduction of world-class maintenance practices at a single plant reduced equipment downtime due to maintenance delays by 13 percent, resulting in almost $5 million in annual savings.

The direct reduction in costs can also be significant. According to our analysis, the portion of a plant's cost structure that is usually addressable—labor, repair and maintenance (R&M) parts and tools, and utilities—accounts for approximately 15 percent of total costs for the typical organization. Experience shows that improvements in maintenance productivity can enable 10 to 20 percent savings on these addressable costs, reducing conversion costs by 2 to 4 percent. (See Exhibit 1.) Manufacturers with a portfolio of plants can potentially capture more value by using a central program-management office to support best-practice sharing and performance measurement.

Maintenance work can be performed according to a predictable schedule using standardized methods and a common set of tools.

Although it will be challenging to change the traditional mindset, the current environment presents an excellent opportunity for manufacturers to pursue productivity improvements in maintenance. Recent across-the-board reductions in labor capacity have resulted in many experienced workers leaving the maintenance function. While older workers still dominate the maintenance labor pool, the proportion of younger employees is increasing, and they are often more open to accepting new ways of working. In addition, contrary to what some old hands may believe, maintenance work can be performed according to a predictable schedule using standardized methods and a common set of tools. Standardization helps to reduce variability in performance and thereby improve productivity. Moreover, at companies that reduced capital investments during the economic downturn, the

EXHIBIT 1 | Savings of 10 to 20 Percent Can Be Achieved Across Addressable Cost Categories



Source: BCG analysis.
Note: R&M = repair and maintenance.

need for improved maintenance productivity is greater than ever. Because these companies' aging equipment requires more attention from maintenance, manufacturing productivity and costs will suffer if the maintenance function does not raise its game to handle the workload.

Why Is Improving Maintenance Productivity So Challenging?

Improving the productivity of maintenance labor is not a simple task. There is no one-size-fits-all approach—manufacturers often struggle to determine which improvement measures to prioritize and the sequence for implementing them. Once an implementation plan is developed, manufacturers must execute it in a way that minimizes disruption to equipment operations and maintenance staff. A transformation involving indirect labor such as maintenance workers is also more complicated than changes that affect direct labor assigned to a machine or line. The nature of maintenance work (fulfilling work orders) makes it more challenging to measure productivity and effectiveness, to identify the root causes of problems, and to make improvements. And a shift in mindset is required to get skilled craftsmen with potentially decades of experience to accept a new approach to their jobs. These overall challenges translate into specific challenges in strategy, execution, and governance.

To define its maintenance strategy, a manufacturer must be able to prioritize areas for productivity improvements. This requires distinguishing among different types of equipment with respect to the optimal level of planned maintenance and the corresponding capacity requirements. The basis for making this distinction is a detailed understanding of which equipment is most critical to plant operations. However, many manufacturers have not made such an assessment of criticality. The failure to set maintenance frequency according to equipment criticality leads to an undifferentiated approach and a misallocation of scarce resources, which at worst can cause highly disruptive breakdowns. Designing an effective maintenance strategy also entails rethinking the traditional roles of production and maintenance personnel—transitioning from "I produce, you repair" to "We are all responsible for equipment upkeep." Beyond addressing mindset issues to avoid conflicts, operators will need training in order to take on routine maintenance tasks, such as lubrication, cleaning, and simple adjustments.

Many manufacturers have established maintenance routines that are hard to change. For example, they rarely reconsider the schedule for preventive maintenance once it has been set. This is especially problematic because manufacturers often base the schedule for maintenance frequency on the equipment supplier's recommendation and do not revise it based on the plant's actual usage pattern. Manufacturers also lack processes to ensure that maintenance and production can coordinate their activities in a dynamic production environment. An unexpected increase in customer demand often means that production cannot give maintenance workers access to machines at the scheduled time.

The maintenance advantage approach allows manufacturers to understand which areas to focus on and how to implement improvements in these priority areas.

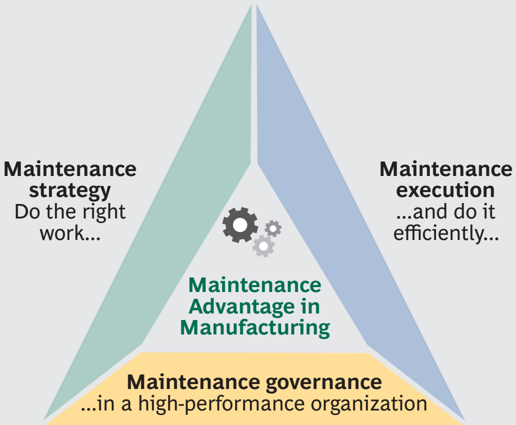
Making efficient use of the maintenance workforce is an especially challenging governance issue. Maintenance labor is typically viewed as a fixed cost. Manufacturers determine the size of the maintenance workforce based on the number of production lines rather than the amount of planned maintenance required and an estimate of unplanned equipment downtime. Also, workers frequently don't have the flexibility to take on tasks as needed because of overly narrow job descriptions—whether pipefitter, welder, machine repairman, oiler, carpenter, tool and die maker, or electrician. What's more, manufacturers often don't analyze how to strike the right balance between decentralized and centralized staffing in deciding whether workers should be dedicated to a line or department or placed in a single labor pool serving an entire plant. And staffing schedules typically don't take advantage of equipment's planned downtime. Plants frequently schedule too many maintenance workers on the first shift, when equipment is heavily used and thus unavailable for planned maintenance, and not enough workers on the second and third shifts, when equipment is more likely to be available.

The New Approach

The "maintenance advantage" approach provides a framework for addressing these challenges. It allows manufacturers to understand which areas to focus on when seeking to improve maintenance productivity, how to implement improvements in these priority areas, and how to ensure that improvements are sustained.

The framework covers three dimensions—strategy, execution, and governance—and comprises 14 activities, or "levers." (See Exhibit 2 and the sidebar, "The Maintenance Advantage Levers.") A comparison with best practices in terms of

EXHIBIT 2 | The 14 Levers of the Maintenance Advantage Framework Address Strategy, Execution, and Governance



1. Reliability- and risk-centered maintenance
2. Planned maintenance
3. Autonomous maintenance
4. Standard work and documentation
5. Elimination of nonvalue-added activities
6. Reduction of planned downtime
7. Elimination of the root causes of equipment failure
8. Planning and scheduling of required maintenance tasks
9. Inventory management of repair-and-maintenance parts and tools
10. Labor optimization
11. Teaming
12. Skills and training
13. KPIs and measurement
14. Insourcing/outsourcing activities

Source: BCG analysis.

these levers is used to assess the maintenance function's performance, and the levers are applied to improve productivity based on the assessment's results. Many plants may already address some of these levers, but few address all of them well. Manufacturers can apply the framework in a four-phase process leading to full rollout.

Phase 1: Diagnostic. The diagnostic phase provides the basis for developing hypotheses about which areas to focus on for in-depth analysis and problem solving. As a preparatory step, whatever information is available from three existing sources should be collected and reviewed:

- The maintenance organization and its cost structure reveal how maintenance resources are distributed across and within plants and can provide insights into how efficiently labor and R&M parts are used.

- The output of the work-order management system can be analyzed to learn about the maintenance process and its performance. Key points to understand include the ratio of preventive to corrective maintenance as measured in staff hours; which machines consume the majority of maintenance time; work order lead-time from initiation to completion; the process for planning and scheduling work orders; and the standard estimates of completion times for work orders. A robust work-order management system is also essential for implementing several maintenance-improvement levers, including standard work and planning and scheduling.

- Maintenance performance relative to KPIs for plants and the network offers insights into how a plant's performance has evolved over time and in comparison with other plants within and outside the network. This analysis is also helpful in identifying which plant is best suited for the initial diagnostic and evaluation of opportunities.

THE MAINTENANCE ADVANTAGE LEVERS

A maintenance function can assess its performance relative to these 14 best practices and apply the levers to improve its productivity based on the assessment's findings. Each lever can be used independently or in conjunction with others.

Strategy

- *Reliability- and Risk-Centered Maintenance.* Conduct criticality analysis and prioritize the degree and type of maintenance work accordingly.
- *Planned Maintenance.* Apply preventive maintenance in accordance with equipment criticality to minimize breakdowns.
- *Autonomous Maintenance.* Engage operators in routine activities to improve maintenance productivity and equipment performance.

Execution

- *Standard Work and Documentation.* Establish standard processes for completing tasks and the expected completion time for each one.
- *Elimination of Nonvalue-Added Activities.* Conduct an analysis of tasks with respect to the value they add, and identify and eliminate those that add no value.
- *Reduction of Planned Downtime.* Maximize planned-maintenance intervals, minimize the tasks performed, and divide tasks to take advantage of equipment downtime.
- *Elimination of the Root Causes of Equipment Failure.* Analyze the root causes of key-equipment failure and address them.
- *Planning and Scheduling of Required Maintenance Tasks.* Conduct cross-functional planning and scheduling of maintenance tasks; utilize a work-order management system to drive improvement and prioritization.
- *Inventory Management of R&M Parts and Tools.* Optimize spending on parts and tools on the basis of usage and cost.

Governance

- *Labor Optimization.* Make efficient use of maintenance personnel by pooling resources, scheduling the optimal staffing level for each shift, and ensuring the right mix of skills.
- *Teaming.* Foster cross-functional collaboration between maintenance and operations.
- *Skills and Training.* Invest strategically in skill development and training (such as training operators to enable autonomous maintenance).
- *KPIs and Measurement.* Set and track clear KPIs and reward high performance; implement visual performance-management tools.
- *Insourcing/Outsourcing Activities.* Evaluate opportunities to insource or outsource (for example, facility management; parts management for maintenance, repair, and operating supplies; and gage calibration).

While these sources provide valuable information, the most critical information for the diagnostic is derived from a new source developed by BCG—the Maintenance Maturity Assessment (MMA). The MMA enables a manufacturer to understand how well it is performing compared with best-in-class performance for each maintenance-improvement lever. The performance gaps identified can be used to evaluate, quantify, and prioritize improvement opportunities. The systemwide view provided by the MMA also helps in understanding which levers will enable the most significant savings.

The MMA assesses the capabilities of a site's maintenance organization with respect to each maintenance-improvement lever as well as its performance relative to KPIs. The assessment uses a combination of observation, interviews, and a review of data and documentation. Each lever and KPI is scored on a scale from elementary to best-in-class capability. For each component, the MMA enables the site to benchmark its operations against a range of maintenance behaviors or performance levels.

BCG's Maintenance Maturity Assessment enables a manufacturer to understand how well it is performing compared with best-in-class performance for each improvement lever.

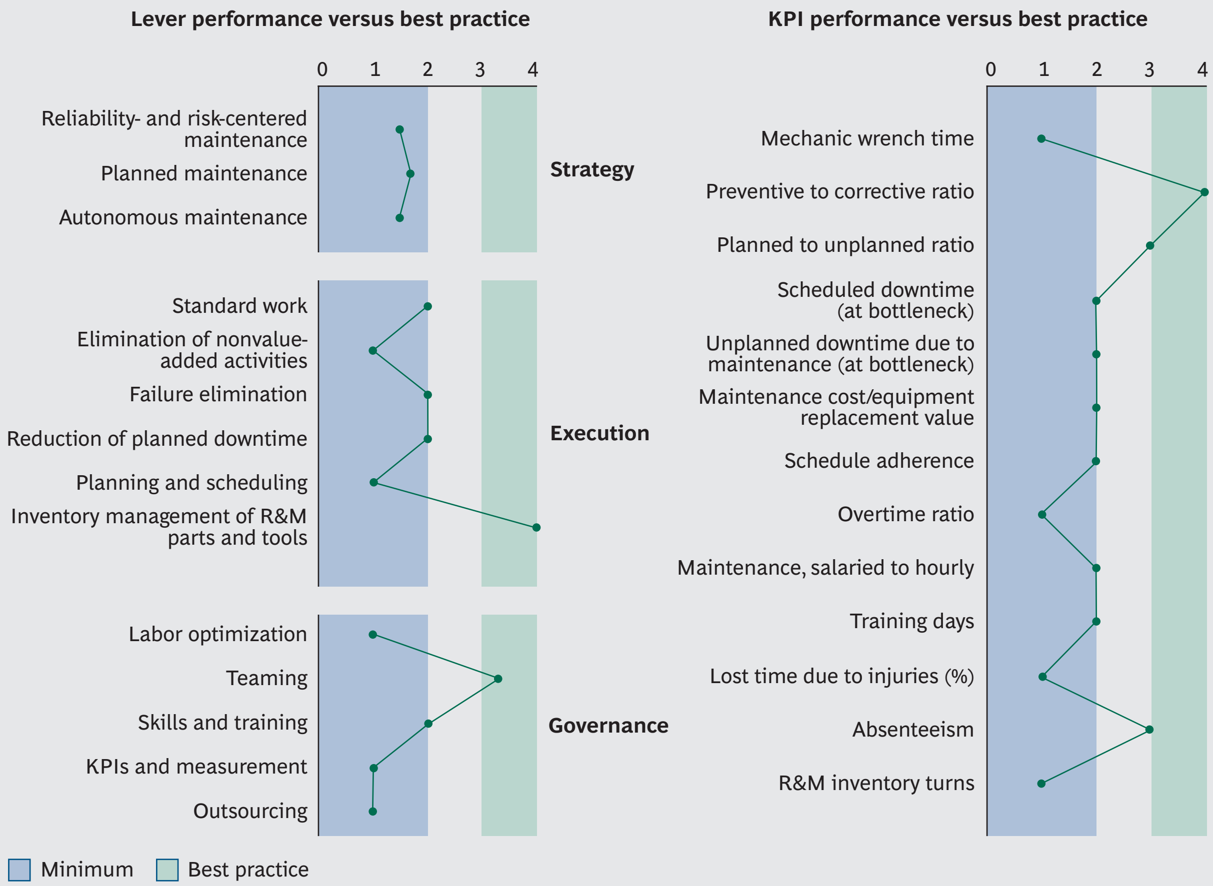
Following the completion of the MMA, key performance gaps relative to best practices are highlighted for the levers and KPIs. (See Exhibit 3.) This provides a qualitative picture of a site's strengths and weaknesses. To enable the savings to be quantified, the levers are grouped on the basis of the cost category in which their application would achieve savings (that is, maintenance labor, R&M parts, utilities, or production throughput). The range of savings is then estimated by leveraging the MMA and associated benchmarks.

On-site assessments—including leadership and plant floor interviews, plant floor observations, and workshops—can be used to confirm the MMA's findings and validate the data collected, as well as provide information for further analyses. Cross-functional workshops are valuable for reviewing the MMA results, discussing and prioritizing high-value levers, and developing hypotheses for solutions. The involvement of a cross-functional team promotes a better understanding of how to achieve operational excellence and increases the likelihood that functions will support the improvement projects.

Phase 2: Solution Identification and Planning. To identify solutions for closing the performance gaps discovered through the diagnostic, the manufacturer should conduct in-depth analyses of the levers identified as being the most critical to improving performance. A standard set of problem-solving tools can be applied in workshops, including the 5 Whys, root cause analysis, process mapping, Pareto analysis, fishbone diagramming of root causes, and brainstorming. These analyses can be supported by further interviews and detailed observations. This phase should identify problems in detail and provide the corresponding solutions, a plan for implementing them, and a savings estimate.

For example, suppose the diagnostic phase reveals that the organization should give priority to the strategic lever of "autonomous maintenance"—engaging operators in routine activities to improve maintenance productivity and equipment performance. That would be the case if operators did not perform routine maintenance tasks, such as cleaning, inspecting, and lubricating equipment and making minor adjustments.

EXHIBIT 3 | The Maintenance Maturity Assessment Highlights Key Performance Gaps



Source: BCG analysis.
Note: R&M = repair and maintenance.

In the solution phase, the manufacturer will first have to understand in greater detail how the absence of autonomous maintenance affects plant performance. That will entail both an inspection on the plant floor and an analysis of historic performance. By cleaning equipment and inspecting it for potential causes of failure (such as dirt or excess vibration), the manufacturer can identify the most common abnormalities. By reviewing historic information on breakdowns, the manufacturer can develop hypotheses about which ones resulted from a lack of routine maintenance or from improper operations. This includes understanding which pieces of equipment are affected and the type of improper operations that occur.

Next, the manufacturer will set up a series of cross-functional, continuous-improvement workshops (or *kaizen* events) to identify solutions and start planning for implementation. Applying the fact base developed in the first step, participants will conduct a root cause analysis to understand the common sources of abnormalities. They will then decide which activities and practices to reinforce, such as standards for cleaning, inspecting, and lubricating equipment. Next, they will develop a plan for training operators on how to improve their operation of machines and determine how maintenance tasks should be allocated between operators and maintenance staff. This will allow the company to finalize the steps and responsibilities for deploying autonomous maintenance. Finally, savings will be estimated on the basis of the expected increase in uptime and reduction in maintenance staff hours.

A baked-goods company used an approach like this to deploy a world-class maintenance program throughout its network of 12 plants. By conducting a maintenance maturity assessment at each site, the company identified priority improvement levers—including planned maintenance, equipment failure root-cause analysis, and KPIs and measurement. It then conducted in-depth analyses of each priority lever to create an implementation plan customized for each site. The estimated savings achievable throughout the network totaled $27 million ($15 million from improved operational productivity and $12 million from reduced maintenance costs).

Phases 3 and 4: Pilot and Rollout. The implementation plan should be piloted in one area of the plant or in one plant within a network, with the objective of modifying the plan as issues arise. The subsequent rollout across the entire plant or network should proceed in waves, each led by a dedicated team. Staff members designated to lead future waves should receive training to hone their implementation skills so that they can lead these efforts independently. This training can be accomplished by "pulling forward" future project leaders to participate in earlier waves. To sustain the changes over time, these leaders can be trained to help other team members meet and adhere to their goals.

Overcoming organizational resistance is often the most difficult challenge to unlocking the full potential of the transformation.

A robust program management and tracking system is a prerequisite for a successful rollout. This must include milestones in achieving the project's targets, early identification of project risks, and identification of areas for further improvement. The bottom-line impact of savings should also be tracked to ensure that the project delivers the intended value.

Getting Started

Before they start the diagnostic phase, manufacturing leaders should agree on the primary benefits they seek from the approach. Is their goal to improve production operations or maintenance productivity, or both? Clearly identifying the overall priority will allow the diagnostic team to develop early hypotheses on the subset of priority maintenance levers best suited to deliver the desired benefits. The leadership team also must understand the extent to which key stakeholders are ready to embrace changes to current ways of working. This understanding can be used to develop a communications and change management plan, as behavioral changes are a prerequisite to successfully piloting and rolling out the approach. Indeed, overcoming organizational resistance is often the most difficult challenge to unlocking the full potential of the transformation.

In the initial health check to evaluate the potential for improvement through the maintenance advantage approach, manufacturing leaders should consider the following questions:

- Do the organization's costs relating to maintenance and machine downtime seem higher than they should be?
- To what extent are production operations negatively affected by equipment performance?
- How effective is the current maintenance program at preventing breakdowns? Has the organization identified the most critical pieces of equipment? Is it allocating maintenance resources accordingly?
- Are programs in place for preventive and autonomous maintenance?
- Does the organization consistently apply efficient standard maintenance practices?
- Does the organization have a robust work-order management system in place?
- Is there sufficient cooperation between maintenance and operations functions in the planning and execution of maintenance activities?
- Is a high-performing maintenance organization in place? Are staff well trained, motivated, and utilized?

For many manufacturers, the answers to these questions will point to opportunities to make significant improvements in the productivity of maintenance labor. The resulting improvement in maintenance costs and overall operating performance will provide a critical source of competitive advantage.

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