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How benchmarking can improve cost competitiveness in steel

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Many debate the relevance of benchmarking in the steel industry. But disciplined application has helped some producers identify improvements of up to 10 percent of the cost base.

Operational excellence is the one improvement lever steel producers control completely. So it's natural that these players are especially cost sensitive and constantly on the lookout for new ways to optimize the cost and performance of their assets. Although many do well on these measures, price and margin pressures are relentless—so achieving a competitive cost position remains high on the agenda, year after year. Yet while steel producers typically know their own production assets very well, there is limited transparency about what is actually achievable across the industry, and how the results might be replicated. What's more, given the many differences among production assets and configurations, it's tough to be sure that a given benchmark is valid for your own operations.

This article reviews the situation the steel industry faces, the importance of cracking the cost challenge, and the potential value of working with multiple operating points (instead of focusing on utilization alone). It then presents a proven method for benchmarking across the industry and invites readers to consider how they might benefit from translating top industry-performance levels into their own assets. Successful benchmarking has helped some steel producers identify further cost-improvement opportunities in the range of 5 to 10 percent of the total cost base.

The ongoing need to crack the cost challenge

Steel producers are fighting hard for financially attractive volumes in nearly all international steel markets. Such opportunities have become much scarcer in recent years. Further challenges to steel producers' performance include exogenous effects such as international steel-trade flows, which are shaped by two major drivers: low transportation costs globally and overcapacity in China.

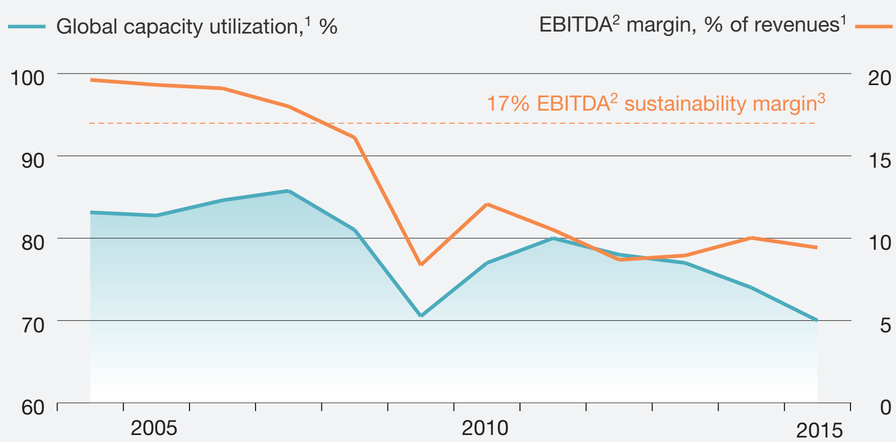
First, let's consider low-cost global transportation, which allows even lower-value-add steel products to travel economically between continents. For example, Turkey now exports rebar and South Korea exports hot-rolled coil (HRC) to the United States; neither was considered economically viable in the past. One consequence is that conversion margins for standard, lower-value-add steel products have declined to their pre-China-boom levels in the 1999 to 2002 period. Consider Europe, where the average long-term HRC conversion margin was $255 per ton (in 2012 real terms). The margin increased during the China-boom period of 2003 to 2008, reaching $400 to $500 per ton and, at the peak, soared to $730 per ton. But by 2009, the margin fell again to $265 to $320 per ton, close to the historical norm.

As a result, there's been further deterioration in average steel-industry earnings before interest, taxes, depreciation, and amortization (EBITDA), which has fallen to 9 to 10 percent, far from the minimum EBITDA margin of 17 percent necessary for the long-term sustainability of the steel business (Exhibit 1).

Turning to the second driver, steel producers in mature markets and especially in China have suffered from significant structural overcapacity in the past three to five years. Average capacity utilization was at only 69 percent globally in 2016. Despite the upward trend to an average of 71 percent in the first five months of 2017, this figure is far below the healthy threshold of 80 percent—and it's also below the 75 to 80 percent level seen from 2010 to 2014, reflecting the severe global slump (Exhibit 2).

Exhibit 1

Growing overcapacity in the steel industry resulted in an average EBITDA margin below the level of long-term sustainability.



[1] Considering sample of 81 companies.
[2] Earnings before interest, taxes, depreciation, and amortization.
[3] Minimum required global average EBITDA margin for long-term sustainability is 17%.

Source: Corporate Performance Analytics by McKinsey; Steel Institute VDEh; World Steel Association

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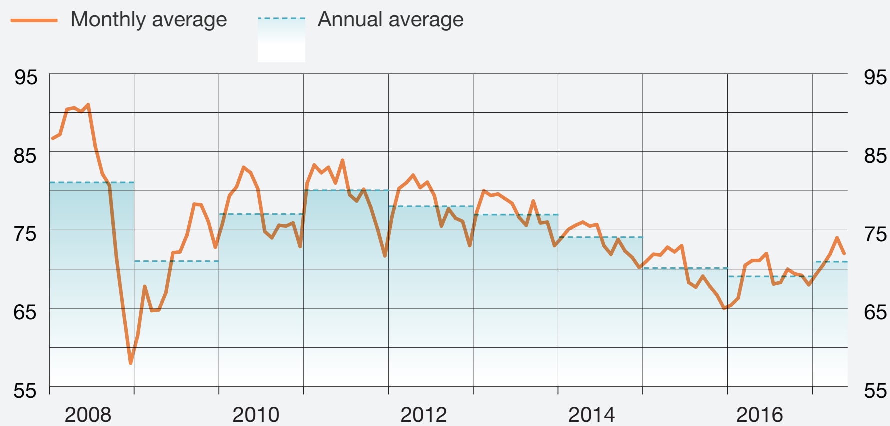
Exhibit 2

Reported global capacity utilization is trending up, reaching an average of 71 percent for the first five months of 2017.

Global steel capacity utilization,[1] %



[1]The capacity estimates from the Organisation for Economic Co-operation and Development are not publicly available and typically don't include idled capacity.

McKinsey&Company | Source: World Steel Association

To address these fundamental issues, steel producers can choose from several options to formulate their agendas:

- Consolidation and structural capacity reduction. This option includes rationalizing existing capacity by exploring M&A and production joint ventures, temporarily idling or closing mills to increase utilization, and shuttering obsolete plants.

- Customer orientation and commercial excellence. To command a price premium and—even more important—increase customer loyalty, companies can differentiate product specifications to protect market position, as well as integrate value-added services with both product and application-specific offerings. For commercial excellence, there are major themes that producers should pursue in parallel: increasing sales-force effectiveness (for example, by using value pricing and by serving the right customers through the right channels) and incorporating more digital solutions into the business.

- Operational excellence. The persistent price-cost squeeze exerts pressure on all steel producers to reduce costs further and drive continuous cost improvement to remain cost competitive.

The remainder of the article focuses on this final point—operational excellence. We see it as the foundation of financial success, since operations is key to delivering on the corporate strategy. Despite the cost focus over the past few decades, and particularly in the past five to ten years, there remain significant gaps between steel producers on operating cost and operational performance. Take HRC production in Western Europe as an example to ensure we are comparing roughly similar factor costs; in many cases, we still find cost differences of 10 to 15 percent between plants with very good practices and those positioned in the third quartile of the cost curve. In our view, that makes the case for why operational excellence to increase cost competitiveness is, and will remain, high on the agenda.

Improving operating cost position

Most steel producers continue to define themselves by their production assets and technical expertise. They aim to deliver the products that customers request on time, with the quality they need, at the lowest cost or with the highest efficiency when the focus is on production volumes.

Given the challenges dogging the global steel industry over the past two decades, many steel producers can look back on a long history of multiple large-scale programs to bring about operational transformations and cost reductions. To achieve sustainable improvements, steel producers have drawn on well-established approaches and tools for improving production processes, such as lean manufacturing and Six Sigma. Lean manufacturing is a production system that eliminates waste, thereby increasing the end-point value for the consumer, while Six Sigma improves the quality of production outputs by minimizing errors.

In addition, commercial project-management systems and tools are available to track the progress of improvement projects—for instance, during idea generation and implementation. What may be more important, however, is using them to track financial impact: that is, realizing the financial benefit of individual improvements and the delivery of the project as a whole.

Thus far, in efforts to close operational-performance gaps, steel producers have focused mainly on the following improvements:

- increasing energy and material efficiency, for example, by reducing the fuel rate at a blast furnace; reducing the yield losses in steelmaking, continuous casting, or rolling; or reducing consumption of energy and consumables

- reducing quality costs by minimizing the amount of rework or scrapped material, for instance, by implementing stricter rules for raw-material input, using more sophisticated process and equipment control, and introducing rigorous root-cause problem solving to better identify and understand the underlying drivers of quality problems

- further increasing labor productivity in direct production by optimizing work flows, investing in automation, increasing multiskilling of operators, and so on

- increasing efficiency in maintenance, for example, by upping the wrench time of the maintenance workforce through better planning and scheduling of maintenance tasks

- further streamlining sales, general, and administrative functions, partly by externalizing tasks or following a shared-services approach for group functions

- reducing external spend when purchasing materials and services, for instance, by better understanding the total cost of ownership of various choices, or by optimizing technical characteristics of purchased materials to meet requirements but avoid overspecification

Today, advanced-analytics methods and digitization enable organizations to make use of the large amount of data continually tracked by machinery and equipment. They have created a new opportunity to optimize operations and reduce costs using digital levers, which typically have a cross-functional impact. Here, the steel industry is lagging behind other industries, but over the past two years, large companies have started implementing such levers, and some have even formulated their own digital vision, including a road map to digitization.

Benchmarking: opportunities and challenges for steel producers

Although benchmarking is a well-known tool, many steel producers have challenged its validity—and they make a good case. The main point of contention goes to the heart of the process: how to identify truly reliable points of reference to assess your own operational performance against a defined "best" standard. But it can be done. After discussing the opportunities and challenges in steel-operations benchmarking, we'll offer a perspective on how to address and handle them. The proven practices are particularly powerful when combined with a tailored approach to identify benchmarks for an individual steel plant or production asset.

The benefits of benchmarking are manifold. It can be a great eye opener, giving steel-company decision makers an external and independent perspective on how well the company, a specific plant, or a piece of equipment performs compared with competitors. Benchmarking also helps to find and prioritize specific areas of opportunity and often confirms or validates assumptions, hypotheses, or gut feelings. Additionally, it can and should be used to set performance targets and expectations. Making benchmarking an integral part of the way a company works can result in valuable data and performance transparency that triggers open and fact-based discussions and performance dialogues, leads to new ideas and improved operational practices, and helps establish a performance- and improvement-oriented corporate culture.

On the other hand, many steel producers face multiple challenges when identifying and prioritizing opportunities for further cost reduction, especially in the production process itself. In our experience, there are several central challenges:

- Growing degrees of freedom—what are the optimal operating points? Steel producers can no longer optimize for one single operating point, which in the past was typically a target for "full utilization." Today, to deal with the challenges of lower or more volatile demand, steel producers need to identify multiple but temporary operating points that fit the actual market conditions and, for these specific operating points, find the "sweet spot": the competitive cost position. In a period of low demand, for example, a producer could gain greater degrees of freedom by defining an operating point with respect to a cost-optimized choice of raw materials instead of a choice that is optimized for throughput (such a choice might involve a trade-off between lower-grade, and thus cheaper, iron-ore products and the resulting higher blast-furnace fuel rate). Working successfully with multiple operating points also implies greater flexibility in the operating system—not only technical and operating flexibility, so a company goes beyond its comfort zone, but also flexibility in organizing the workforce, shift systems, and more. To gain greater flexibility, for instance, a company might shift from using continuous casting with two casters and two crews in parallel to an alternating operation with two casters but only one crew, which requires the caster operators to be multiskilled.

- Transparency as starting point—what performance levels do other steel producers achieve? For the most part, steel producers know their own assets inside and out and understand the performance levels they have achieved in the past. However, as a result of stricter corporate-compliance guidelines and greater caution about revealing details of processes and technologies to competitors, there is limited transparency about what is achievable across the industry and how results might be replicated. Despite being open to sharing information and having a constructive dialogue, it can be tough to find external inspiration to imagine what a future state could look like, and how to navigate a path to peak performance that is at or beyond a benchmark. This is especially tough for producers that operate only a small number of assets and are not part of a group of assets large enough to allow for an internal benchmarking or comparison. Companies considering or conducting a benchmarking effort also need to have a good understanding of what assets should be included in the benchmarking peer group.

- Adjusting benchmarks to fit real boundary conditions—how can we avoid mixing up structural and performance differences? When conducting a benchmarking effort, the major challenge often is to ensure a valid "apples to apples" comparison to derive a realistic but ambitious target level that also gets buy-in from both management and the operations team. The question boils down to how to decompose and classify an observed operational difference into its parts: the structural differences, which are typically much harder to address, and the operational performance gap, which usually can be closed with a targeted improvement project.

  Structural differences come in many forms:

  - Technology differences. Are fundamentally different technologies and capacities being used? For example, compare the blast-furnace process with the FINEX process, or continuous hot rolling mills versus Steckel mills; there may also be scale effects for blast furnaces and rolling mills with different nominal capacities.

  - Equipment differences. Although equipment may be comparable, design choices or equipment variants (often resulting from an evolutionary development of the equipment design) could affect performance parameters—such as yield and raw-material efficiency, for instance—the shape of the blast furnace, top blowing versus combined blowing in the basic oxygen furnace, or hot rolling mills with and without coil boxes.

— **Customer and product-portfolio differences.** These might include having a high share of small-volume and less standard steel grades, leading to shorter casting sequences and lower casting speeds.

— **Factor cost differences.** Such differences, especially for labor, often lead not only to structural cost differences but also to productivity differences in person-hours per ton. For instance, take the difference between countries with lower-cost labor, such as China (€8 to €12 per person-hour), and those with higher-cost labor, such as Germany (€35 to €40 per person-hour). It is easy to grasp that there is a good business case in Germany for installing a downcoiler with a fully automated binding and labeling machine at a hot rolling mill, but not in China, where there is a cost advantage in doing the same work with three employees per shift.

— **Regulatory regime differences.** These could necessitate additional specific job positions to meet safety standards, or stipulate the installation of more equipment to meet emission standards. The same logic holds for the cost of carbon dioxide emissions.

Understanding these differences lays the groundwork for designing and implementing improvements that promote operational excellence and enable steel producers to work with multiple—and cost-competitive—operating points, ultimately increasing their profitability.

Proven benchmarking approach and best practices

Given the challenges, the benchmarking of steel operations nearly always sparks lively debates. Yet, since its value in identifying improvements is also widely appreciated, benchmarking is now applied regularly in steel and most other process industries.

This brings us to the main questions for individual steel producers: What's the best way to conduct a benchmarking exercise, overcome the challenges to making valid comparisons, and derive actionable insights? We believe that a technical or operational benchmarking effort in the steel industry should follow a three-step approach: baselining, normalization and benchmarking, and opportunity sizing and prioritization (Exhibit 3).

Baselining: Collect and prepare operational and financial data

The benchmarking should be conducted for a representative reference period reflecting stable and typical production cycles. This baseline period needs to be a real baseline and could cover a fiscal year or a specific quarter. It should exclude special effects such as longer-term downtimes that affect operational key performance indicators (KPIs) and make them unrepresentative.

In our experience, it is important to ensure that the definitions of operational KPIs provided by the production areas are aligned and consistent with the information of the finance department. The cost baseline needs to cover the same period as the operational baseline and break the costs down per process step and major cost category. This is vital both to simulate a consistent cost build-up for each process step along the value chain and to quantify how much a change to an individual KPI will, in turn, change the cost of the finished product.

Exhibit 3

A three-step approach for benchmarking steel operations can help generate useful insights.

	Baselining	Normalization and benchmarking	Opportunity sizing and prioritization
Main activities	• Define reference period • Collect operational key performance indicators (KPIs) and cost information • Ensure consistent definition of KPIs	• Create transparency about differences between own equipment and benchmark • Normalize KPIs • Split gap to benchmark into structural difference vs performance gap	• Define KPI targets (with or without capital expenditure) • Ensure buy-in from stakeholders • Roughly quantify financial opportunity • Prioritize improvement areas for launch of immediate idea generation
End products	• Real, representative, and consistent historical baseline for operational KPIs and production costs	• Transparency about the total gap to benchmark for operational KPIs • Clear understanding of structural differences vs performance gap	• Ambitious KPI targets signed off by stakeholders • Rough "value at stake" • Clear understanding of priority areas

McKinsey&Company | Source: SteelLens by McKinsey

Normalization and benchmarking: Make KPIs consistent, measure them, and distinguish between structural and performance differences

As mentioned, a critical challenge in benchmarking is to ensure valid comparisons in order to derive a realistic target level and get buy-in from all relevant stakeholders, especially in operations. But it is also highly relevant from a cost standpoint. Differences in blast-furnace productivity lead to substantial differences in coke consumption, hence differences in raw-material cost—and, depending on raw-material choices, also affect the amount of gas credits. Similarly, at the hot strip mill, different equipment designs, the share of hot charging, and the use of gases other than natural gas can lead to a difference in natural-gas consumption of up to 50 percent. Because the differences are typically quite numerous and diverse, we focus here on a few examples to illustrate how we think about calibration and normalization to ensure accurate benchmarks.

- Blast-furnace productivity is a good example of an indicator that typically needs adjustments for various sources of differences. Even blast furnaces with the same or similar design need adjustments to reflect differences in the way they are run, as productivity can easily vary by two to three tons per cubic meter per day. The choice of raw materials typically differs depending on the products to be made. Adjustments may also be necessary for typical KPIs such as fuel-rate changes. Gas credits may differ when volumes are changed, potentially resulting in differences in cost performance. It follows that the way the benchmark for blast-furnace productivity is assessed needs to be adjusted to align with the selected operating point.

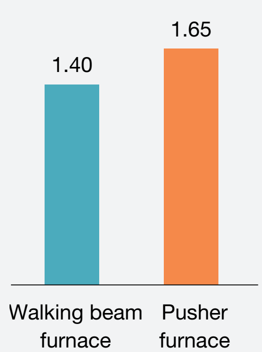
- Gas consumption in a hot strip mill. The consumption of reheated furnace gas by a hot strip mill illustrates how different technical and operational factors influence this critical and cost-relevant operating KPI, hence the energy cost at that process step (Exhibit 4). First, it is crucial to understand the impact of the product portfolio, given that electrical or high carbon steel grades, for example, require higher reheating temperatures than standard structural steels. Beyond this portfolio effect, it is also important to consider technical differences such as furnace type, waste-heat recovery, and use of a coil box. None of these differences can be readily optimized with operational-improvement initiatives. Instead, they require significant investments in new equipment or upgrades. In contrast, the share of hot charging is another important a factor that can be addressed to some extent, as it depends on the quality of production planning and internal logistics processes. It is possible to achieve a hot-charging ratio of more than 50 percent, depending on the complexity of the product portfolio.

  Integrated plants often use internal coke-oven gas and blast-furnace gas. Compared with natural gas, the composition of these gases is less stable and consistent, resulting in a less-efficient burning process in the furnace. Nevertheless, despite the higher gas-consumption rate, it is typically an economically viable trade-off.

Exhibit 4

When benchmarking gas consumption, adjustments need to be made for differences in the technical setup of hot strip mills.

Base case gas consumption,
GJ/t[1] HRC[2] black



Typical adjustment needs,
GJ/t

Item	Description	Benefit
Hot charging	If 100% hot charging	**0.30**
Coil box	Penalty if 100% through coil box (0% direct roll)	**–0.50**
Waste heat recovery	If waste heat recovery installed	**0.13**
Degree of automation	If average degree of automation	**0.07**
Degree of automation	If high degree of automation	**0.14**

Note: Benchmark value depending on type of reheating furnace plus various other technical parameters of the strip mill.

[1] Gigajoule per ton.
[2] Hot-rolled coil.

McKinsey&Company | Source: SteelLens by McKinsey

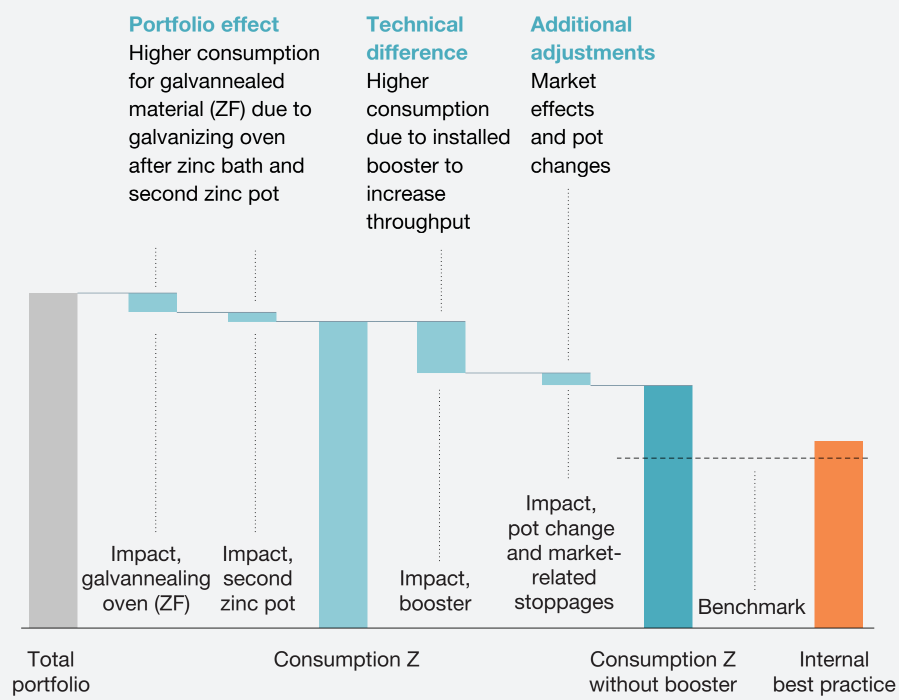
- Power consumption of a galvanizing line. Structural adjustments to this KPI are similar to those for gas consumption in a hot strip mill (Exhibit 5). If the product portfolio includes galvannealed material, it presents a technical difference as well, because this material requires an additional annealing furnace where the coated strip passes directly above the zinc pot. A producer with this type of asset also needs to consider the installation of a booster, which accelerates the strip heating before the strip passes over the zinc pot. The benefit is the incremental increase of galvanizing line capacity without significant investment.

- Labor productivity. How to handle this variable is often the most common question raised when benchmarking. Fundamentally, two options exist. The first is a typical top-down approach, which compares person-hours needed per metric ton of production. This number is driven directly by the production volume, which can vary over time due to planned downtimes and product-portfolio effects—for example, a large share of products with low specific productivity or long process times. To derive an improvement potential from this number requires consideration of company- or country-specific differences in

Exhibit 5

Electricity consumption of galvanizing lines may need to be adjusted to get to a valid benchmark comparison.

Adjustment to electricity consumption of galvanizing line, KWh/t[1]



[1]Kilowatt-hour per ton.

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annual working hours per ton and resulting shift models. All in all, this is good enough for a rough indication, but to surface and understand the underlying differences, more insights are required.

It is therefore preferable to base labor-productivity benchmarking on the actual staffing positions per shift for a specific piece of equipment (Exhibit 6). This approach typically makes crystal clear which differences can be addressed by optimizing the work flow, reallocating tasks, and building operators' multiskilling capabilities, as opposed to differences that need some investments in automation.

Opportunity sizing and prioritization: Define KPI targets, quantify the improvement opportunity, and prioritize improvement areas

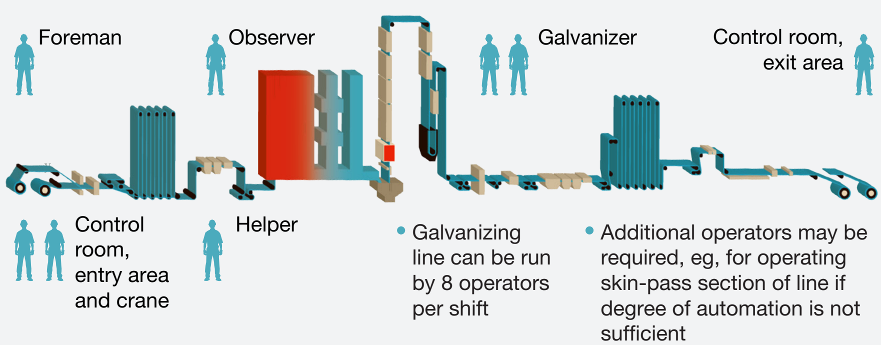
After identifying the performance gaps for the most relevant operational KPIs, the third and final step is to derive future targets for each KPI. Ultimately, the objective is to reach (or surpass) the benchmark performance level. However, implementation takes time, especially when it requires changes to operational practices or investments in equipment.

The KPI normalization and adjustments made during the course of the actual benchmarking now enable the team to differentiate between performance levels that are addressable entirely by improving operating practices, process parameters, or task allocations, and those that need smaller or larger investments. On the basis of the capital expenditures available and required payback times, the team should plan an ambitious ramp-up of the KPI improvement aimed at the attainable benchmark level. A comprehensive benchmarking effort will typically identify numerous improvement opportunities. Addressing all of them at the same time is

Exhibit 6

Labor-productivity benchmarking should be based on the technical job positions required to operate the line.

Required technical job positions for a galvanizing line,
number of operators per shift



McKinsey&Company | Source: SteelLens by McKinsey

generally not possible for several reasons: limited funding for capital expenditures, resource constraints (people with the necessary capabilities and capacity), or an urgent need to capture savings as soon as possible. In such a context, the improvement areas should be classified by priority (short term, midterm, and long term). To enable the management team to make an informed decision, the expected financial impact should be at least roughly calculated for all improvement areas—without detailing individual improvement measures.

One of the most important objectives of a comprehensive benchmarking project, including normalization and adjustments, is to create full transparency and a fact base of comparisons of actual performance data and a best-practice plant. This is crucial not only for the management team but also for the production teams and individual operators. Full transparency helps ensure buy-in to ambitious performance targets for operational KPIs that the production team can really influence. If this transparency is in place, operators typically demonstrate strong commitment and willingness to sign off on individual improvement measures with clearly defined KPI and financial-impact targets.

Capturing the improvement opportunities

Even after applying the three-step benchmarking approach, there's a need for action, so the improvement opportunity can be captured. The next step is to develop concrete measures or initiatives. Ideas for closing gaps can be developed in different ways:

- holding classical idea-generation sessions with production crews or interdisciplinary working teams; success here hinges on a well-structured approach, for example, that accounts for major cost buckets (which should be prioritized)
- conducting thorough best-practice sharing between plants (if possible)
- reviewing operational- and technological-impact cases as published in industry papers
- building on ideas not executed in the past
- reviewing historical KPI trends and respective historical practices and procedures
- encouraging close collaboration and joint idea-generation sessions with suppliers and contractors (for instance, to optimize external production and maintenance services)

The basic premise for generating ideas is that the people who perform the work must own the initiative, from idea to recognition of bottom-line impact in financial accounts. Typically, it is the most senior person in the relevant area or function who drives the initiative on a day-to-day basis. Another common issue is that people tend to skip detailed initiative planning and plunge immediately into execution when they know what needs to change. However, we believe it is absolutely critical to be disciplined and carry out bottom-up planning for all improvement initiatives that will be implemented. It's essential, for instance, to ensure a valid quantification of the financial opportunity combined with the expected ramp-up of the cost savings over time and to make sure that targets for operational KPIs are defined to track technical implementation of an initiative.

That brings us to another important element of an improvement project—setting up a tracking process. In our view, rigorous tracking of operational KPIs is essential to ensure that improvements are implemented as planned, and that the KPIs actually do reach target levels. It is equally important to track the financial impact against the defined baseline to ensure the realization of the financial benefit of individual improvements and the project as a whole. □

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