

Lean operations

Preparing for lean times

Pulp and paper companies in Europe and the United States are going through a difficult time. Industry costs have been rising by 9 percent a year since 2007 but prices have increased by only 2 percent annually, so profitability remains low across the value chain. Demand is shrinking in some developed markets and barely growing in others. Only in emerging markets is demand growing strongly—but new, lower-cost capacity in the Southern Hemisphere, especially in Indonesia and South America, is competing to meet these new needs, pushing market prices down. At the same time, tighter regulation across the globe continues to drive up costs as producers strive to consume less energy and water and to cut their carbon dioxide and effluent emissions. Many pulp and paper companies are committed to tighter environmental targets than regulators demand, and investing to be sustainable in the future is inevitably adding to their costs today.

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Under such dreary circumstances, what can pulp and paper companies do? The only options for less cost-competitive mills in Europe and North America are to develop new business models, such as generating bioenergy from pulp, or to refurbish mills. The second option may prove to be a more fertile opportunity than it sounds, however. Over the past five years, McKinsey teams in developed economies have worked with many pulp and paper mills to make their operations leaner. Results from these projects indicate that a typical mill can expect to reduce fixed costs by around 15 percent in this way.

Perhaps more surprisingly, in view of recent rises in the price of raw materials and energy, mills can expect their variable costs to fall by 5 to 10 percent as well. Mills undertaking such projects have seen their overall equipment effectiveness (OEE) and yields improve at the same time, so they have increased output significantly without investing large sums of capital or taking on more people. Since most of the measures these mills are using to streamline operations can be put in place in less than a year, the results have shown up quickly in the bottom line.

Mills must look for opportunities to work differently across the entire scope of their operations

To capture the full benefit of a lean philosophy, mills must look for opportunities to work differently across the entire scope of their operations, from production, maintenance, and energy to sales, general, and administrative areas. In this paper, we outline some of the approaches based on classic lean principles (such as reducing waste, managing performance, and following standard operating procedures) that we have tailored to uncover and extract fixed and variable costs and increase OEE and yields in pulp and paper operations.

Implementing lean operations across the board may be the option that delivers the largest gains to a mill, but doing so entails a substantial commitment of time and resources. Many mills could also see substantial benefits from introducing a more limited set of targeted

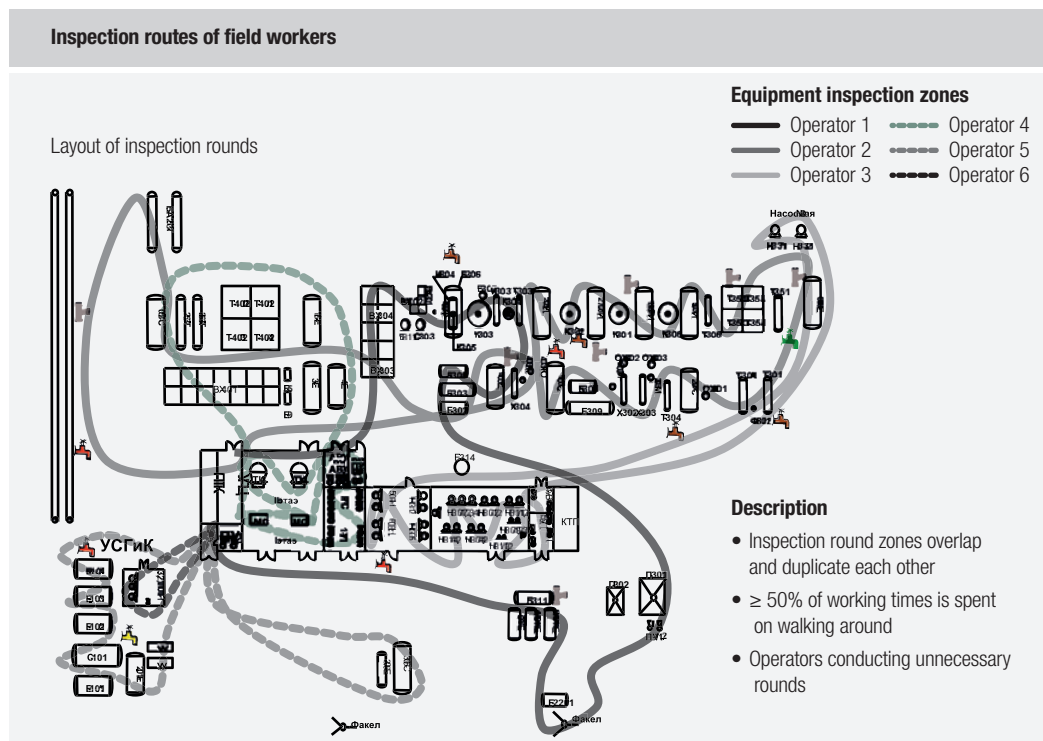
initiatives. To meet this need, we conclude the paper by setting out three differently scaled options for organizing a state-of-the-art lean-operations program for pulp and paper mills.

Unlocking classic lean potential

Why are classic lean principles so helpful in making pulp and paper operations more productive? In most cases, it is because they focus attention on operational processes at an unusually granular level, both from end to end and at the different interfaces, in order to diagnose opportunities for saving time and resources.

Examples of such diagnostics at real mills illustrate this point. Take the process of recovering after a web break. Close observation of what happened during web breaks at one

Exhibit 1
Workload analysis reveals unnecessary duplicate inspection as opposed to purposeful inspection



Source: McKinsey client example, McKinsey analysis

mill revealed a surprising number of ways to improve the process. The mill typically took 20 to 25 minutes to recover from a web break, each time wasting an average 8,000 tons of paper, which then had to be recycled. Recording what happened at each stage of the recovery — cleaning up, reinstalling the web, and restarting the machines — showed that having more people undertake specific tasks at critical moments would speed the process overall.

For example, three people could judge better than two when to lower the reel back into position before restarting the line. Although there were generally five people within ten meters of the web break and five more people on hand in the control room, they did not know how to work together to optimize the critical tasks. As a result, three people might work on a reinstallation task that

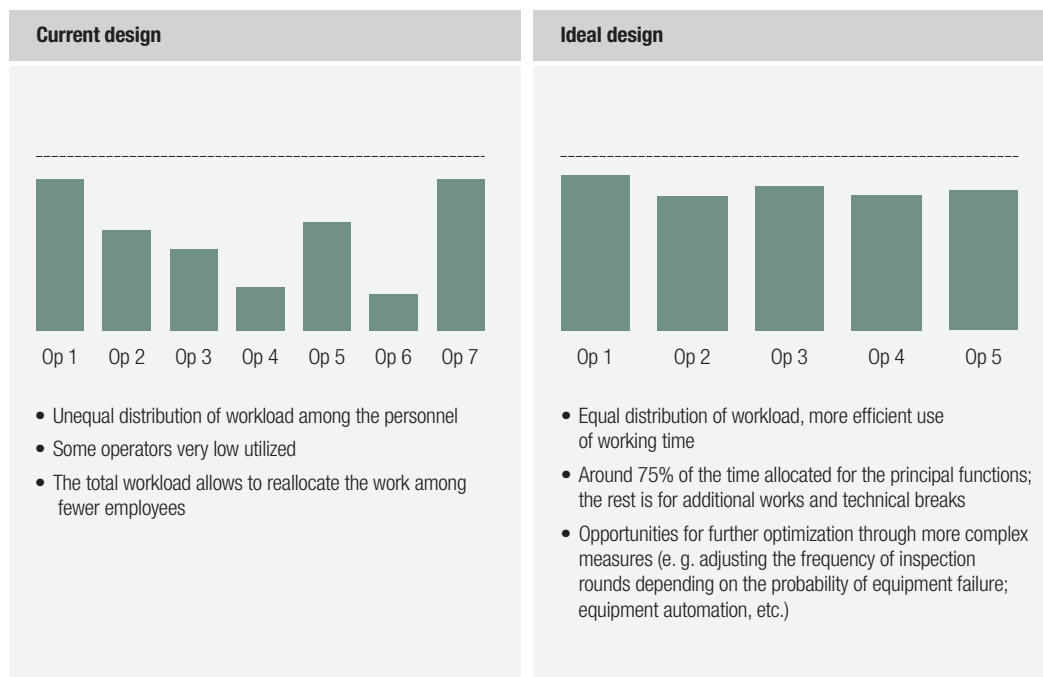
needed only one pair of hands, while two others who were not far away struggled to get the reel back into the right place. Training employees to collaborate on critical recovery tasks could cut the time it takes for this mill to recover from a web break by 30 percent.

Close analysis of a task can also reveal significant differences in how different operators carry out the same operation, pointing to best practices and to the benefits of introducing those practices more widely. Exhibit 1 shows routes taken by six field workers charged with inspecting the machines in another mill’s shop. The “spaghetti” diagram produced by plotting their trails shows how much the routes varied. That variation indicated a lot of unnecessary duplicate inspection at the mill and unproductive walking around instead of purposeful inspection.

Exhibit 2

Workload analysis reveals inefficiencies and enables more fair redistribution of work

Time of operators to fulfill principal functions in designated area
Hours



Source: McKinsey client example, McKinsey analysis

Similarly, analysis at another plant of how long it takes different operators to do their allocated jobs revealed significant variation in the time they spend working during each shift (Exhibit 2). Redistributing jobs more efficiently would not only result in each worker having a fairer share of the work but also ensure that five employees could complete the same amount of work as seven under the old regime.

Analyzing variable costs to reveal high potential savings

Fixed costs have been the main focus of programs to streamline operations over the past decade. Yet rising raw-material and energy prices in recent years have significantly increased the already-large share of variable costs in pulp and paper mills' total expenditure. Fortunately, analyses to diagnose avoidable sources of variable cost and waste have been developed, as have ways to eliminate these sources, and at the same level of detail as those that work for reducing fixed costs. Here, the principle is to look for variations in input consumption over time, understand their causes, and use that understanding to steer average consumption closer to the optimal level. Again, examples taken from real mills can make the principle clearer.

The basis weight of an important product in one mill's product mix showed variations over time. The mill's customers require an average basis weight of 80 grams, but checking the actual weight over nine months showed it averaged 81.3 grams, a margin that gives the mill room to reduce its input of fiber substantially and still meet the standard its customers expect.

Mills can reduce their chemical costs using a similar approach. Take surface starch. Sharply rising starch prices mean even slight increases in consumption can have a disproportionate effect on total costs. At one mill, over 18 months, one paper machine's average consumption of surface starch per ton of finished paper rose by 3 percent, but that modest rise pushed up

total costs per ton. Closer analysis revealed that surface-starch consumption varied by 22 percent over the period between the months of lowest and highest consumption, primarily due to variations in the moisture content of starch procured from different suppliers and differences in the viscosity of the starch mixture prepared in the plant and in the doses applied. By switching to fewer, higher-quality suppliers and training employees to follow a standard process for preparing and applying the starch, the plant could potentially reduce its expenses per ton on this chemical. Taking the same approach to all chemicals used by the same machine could produce significant savings.

Another important source of variable cost for a paper mill is the process steam produced by the mill itself. For this kind of utility cost, comparing demand for the utility over time with the cost of producing it can reveal opportunities for substantially reducing the total cost of owning the utility. Exhibit 3 shows one mill's demand curve for steam. For about 40 percent of the year, the mill needs between 110 and 175 tons of steam per hour. But for more than half the year, it needs less than 110 tons per hour, and it needs more than 175 tons for just 37 days. At present, it has seven boilers operating at different levels of efficiency and uses all seven at different fractions of full capacity. Comparing the demand and cost curves shows that the plant could meet all its steam needs the whole year round by using more of the capacity available from its four most cost-efficient boilers without having to draw on its three least efficient boilers at all. See the following article for further discussion of energy efficiency in paper making.

Putting lean into practice

The disciplined application of lean principles to pulp and paper processes can yield highly effective measures, but implementing some of them will require widespread and significant changes in behavior. For instance, applying knowledge yielded by the "high resolution"

Different mills will have a different appetite for diagnosing and capturing lean efficiencies

analysis of steam demand and cost curves described above would require staff and managers across the site to coordinate on developing and practicing a new way of managing steam production. But other measures may be generated and implemented more easily. Different mills will have a different appetite for diagnosing and capturing lean efficiencies, depending on the scale of improvements they need to make and how quickly they need to make them.

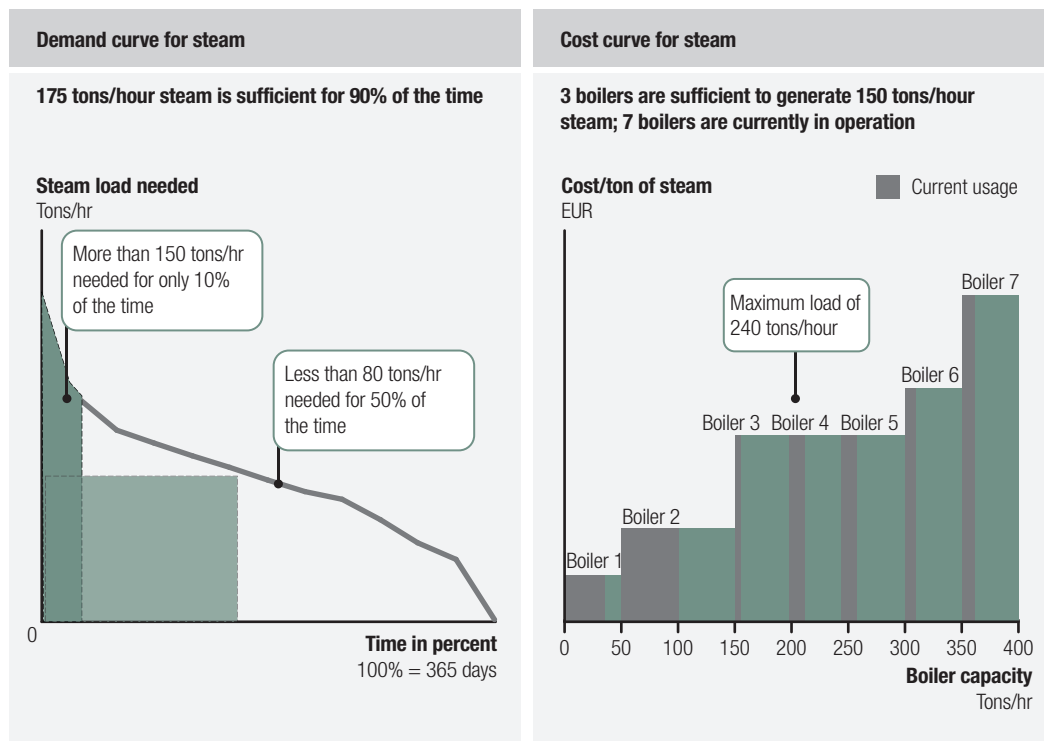
We have found three kinds of approaches effective in defining and capturing efficiencies: one generates a bundle of discrete improvement measures, one involves the complete transformation of an entire site or part of a site, and the third combines the other two. All three start with a thorough diagnostic to identify the

highest-potential areas for improvement and define a financial target.

Diagnostic. The diagnostic process takes three to four weeks, depending on the size of the mill in question. It begins with one to two weeks of preparation, during which the diagnostic team, comprising McKinsey analysts and their counterparts from the paper mill, request the data they need from the plant to produce a rough material-and-information-flow diagram for the site or parts of the site under examination. They also form some hypotheses about where the best opportunities might lie. An on-site diagnostic lasting two to three weeks follows, during which the team develops a detailed understanding of all business processes by interviewing key line managers and spending time on the shop floor, while constantly testing their hypotheses

Exhibit 3

Comparing demand for process steam and the cost of producing it could lead to opportunities for reducing total cost



Source: McKinsey client example, McKinsey analysis

Pulp and paper companies can also make significant gains from lean projects targeting just a single site

and comparing what happens at the mill with best practices. The team then delivers its recommendations on the main levers for improving each core business process along with specific measures to generate improvements and capture the potential financial impact of each measure. At the same time, the team will aim to gain buy-in from those people at the site on whom the success of each measure will depend and to identify the cost of any new assets they recommend.

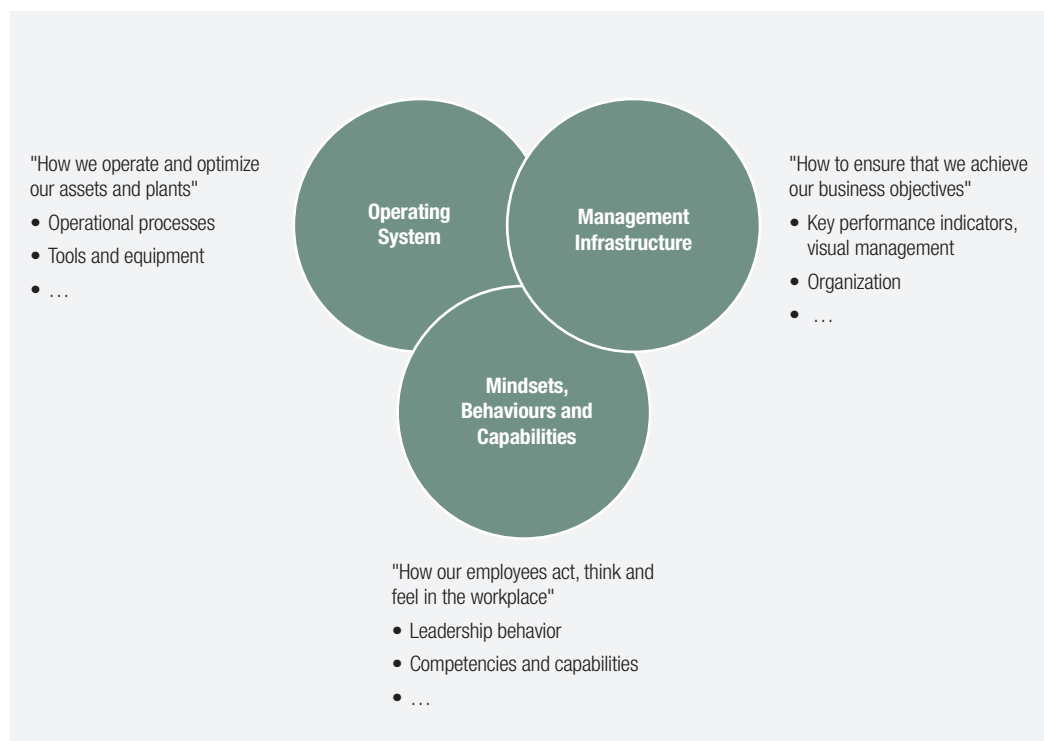
Measure generation. This approach generally suits less sophisticated sites, where a bundle of individual measures has a good chance of capturing the lion's share of any improvement potential. It engages production managers, shift leaders, and the project team and its sponsors over a period of 9 to 12 weeks. Taking the

diagnostic as its starting point, the project team convenes brainstorming sessions to generate up to 1,000 ideas to improve technical systems. The project team and production managers then make a rough assessment of each idea to find the top 400. They evaluate these ideas—including their required capital spending, likely impact, and the time it would take to put them in place—to arrive at the best 100. Over the final two weeks of the project, the full team draws up an implementation plan for these 100 measures, taking capital and personnel constraints into consideration.

Transformation. This approach suits sites that are already performing fairly well and need to address processes and financial performance on a number of linked dimensions to improve further. These are much larger-scale transformation projects, taking 6 to 18 months to do an in-depth

Exhibit 4

A holistic approach allows teams to diagnose opportunities for savings



Source: McKinsey analysis

diagnostic and develop implementation plans, followed by 5 to 8 months of implementing and fine-tuning new processes and ensuring continuous improvement. The diagnostic covers not only the operating system but also how it is shaped by the management infrastructure and the mind-sets and behaviors of everyone working on the site. Designing future operating processes similarly embraces everyone who will play a part in each new process, as well as covering the technical aspects of the processes themselves. Complete transformations are directed at entire sites, but “mini-transformations” can be developed to target parts of a site or particular functions or production issues. An example of such an issue could be energy use, in the case where the diagnostic indicates that a holistic approach is likely to be most effective (Exhibit 4).

Hybrid. Under this approach, individual cost-saving measures can be generated across a whole site at the same time as mini-transformations that involve the same attention to management, mind-sets, behaviors, and capabilities as site-wide transformations. Such mini-transformations target particular areas of improvement—for example, OEE or maintenance—to change practices across the whole site, from the site manager’s office to the shop floor. This kind of project entails some site-wide measures to change mind-sets and improve capabilities at all levels; it also introduces an integrated system to track key performance indicators and establish continuous improvement.

Reaping the rewards

Significant resources are required to capture all the opportunities that this approach can yield — not always in the form of capital expenditure but certainly in management time and attention. The stakes are high. Reaping the highest rewards would probably require a program for transforming the full network of a company’s mills and plants, which in turn would require the highest input of resources. But our experience shows that pulp and paper companies can also make significant gains from lean projects targeting just a single site or part of one site.

Although lean operation is a familiar concept in process industries, not all pulp and paper managers are aware of the scale of benefits it can bring to their plants. Success depends on an exceptionally “high definition” analysis of current practice. It also depends on willingness across the organization to change not only the work done each day but also mind-sets and behaviors, so that looking for ways to be leaner becomes second nature.