DESIGN GALLERY™

VOLUME 3

PACKAGING MACHINERY

A SUPPLEMENT TO

FOOD&BEVERAGE PACKAGING

Market Insights to Packaging Solutions

Performance Benchmarking

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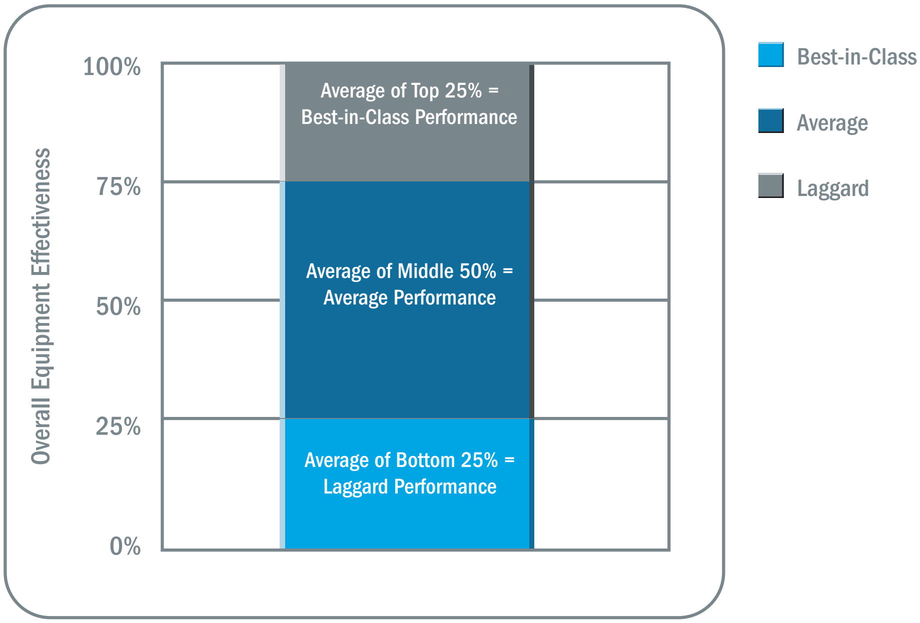
Much has been written about the increase in food costs over the past year. Food and beverage manufacturers face high commodity costs on the supply side and even higher fuel costs on the customer/distribution side. Landing in the middle of this cost equation, manufacturers have no choice but to pass along costs to consumers, rather than adversely affect profitability. Forward-thinking organizations have spent significant effort addressing efficiencies on the supply and customer sides.

Those same leaders now view manufacturing operations as another way to attack costs to maintain a competitive price advantage or improve profitability. They leverage continuous improvement methods such as Lean Manufacturing, Six Sigma and Total Productive Maintenance (TPM). The fuel that powers these methods is a series of operations metrics, measured frequently and delivered to all levels throughout the organization for the purpose of managing these programs.

While metrics vary depending on the program, a common metric for food and beverage manufacturers is conversion cost per ton. This measurement is the net efficiency without any commodity costs. We can derive or calculate conversion cost per ton based on the common operations metric OEE—Overall Equipment Effectiveness.

From January to June 2007, Informance studied 220 consumer packaged goods (CPG) manufacturing lines worldwide, including a large percentage of food and beverage manufacturers. Researchers used the Informance Enterprise Manufacturing Intelligence Suite (including patented analytics), and IMPACT Advisory Services to collect data, derive insight and discover correlations to operational success of tactical and strategic actions.

CHART 1: DEFINITION OF BEST-IN-CLASS



Here are key findings:

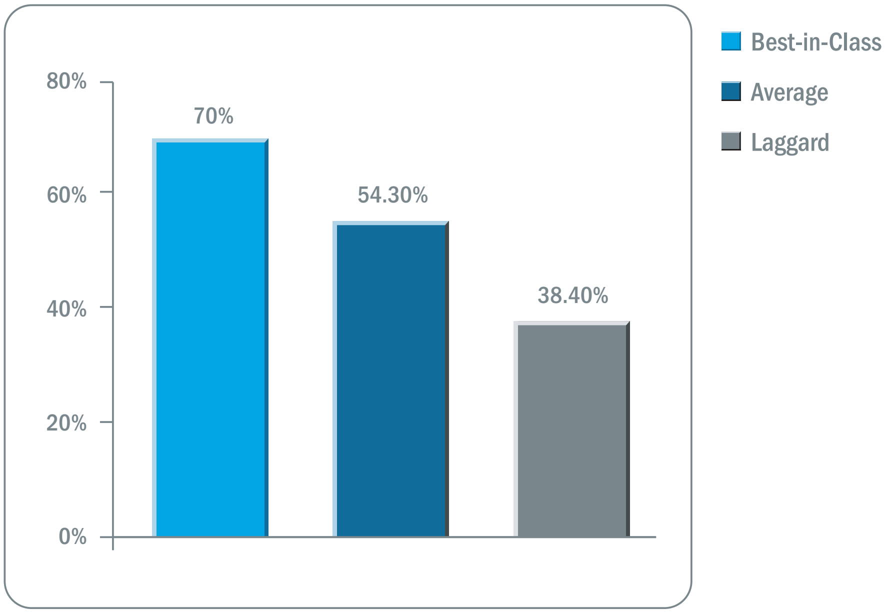
- Best-in-class performers exhibit 1.8 times OEE over laggard manufacturers.
- Laggard manufacturers experience minor stops 2.1 times more frequently than best-in-class performers (minor stops are those with a duration of 10 minutes or less).
- Best-in-class exhibit an average length of changeover time of 17 minutes, versus 50 minutes for laggard manufacturers.

To determine a manufacturer's competitive position, we use OEE as the top indicator of performance. We rank each manufacturer by OEE and view all other key performance indicators (KPIs) in context of this order. The average of the top 25% represents best-in-class performance for that KPI, the average of the middle 50th percentile represents average performance and the average of the bottom 25th percentile represents laggard performance (see Chart 1: Definition of Best-in-Class above).

BEST-IN-CLASS DIFFERENTIATORS

Best-in-class food and beverage manufacturers excel in overall equipment effectiveness over average and laggard counterparts (see Chart 2: Overall Equipment Effectiveness on p.6). At 70%, best-in-class OEE is ▸

CHART 2:
OVERALL EQUIPMENT EFFECTIVENESS (OEE)



31.6 percentage points higher than the 38.4% exhibited by laggards. This is good news for best-in-class performers, since they have already achieved significant gain over their counterparts, and are likely masters in some areas that affect performance.

OEE is a primary indicator of performance. During the study, researchers examined all manufacturing KPIs (key performance indicators) in context against best-in-class, average and laggard OEE performance. They used this approach to understand which KPIs can be used as indicators of performance, measuring the size of the gap from laggard and average performance to best-in-class.

For example, while there might be nearly double performance in OEE (1.8 times) between best-in-class and laggard, there may be a much larger gap in other metrics (as much as 10 times or more). Researchers consider a large disparity in any KPI an attribute of best-in-class performance, and point to these areas as potential areas of improvement for average and laggard performers.

Why focus on OEE as a key metric? As a diverse industry, the reasons are as varied as industry segments, sub-segments and vary even by company. Larger companies leverage advances in supply chain and logistics efficiencies by consolidating plants and requiring increased capacity from remaining plants. Certain segments in the beverage industry (like waters, specialty waters and specialty juices) have experienced soaring demand and capture market share by producing more product.

The “hidden factory” is also a compelling reason to measure OEE. For example, consider a manufacturer with 10 factories that each produce one-tenth of the total output. Increased demand, a new distribution channel or any one of a myriad of other reasons might dictate additional output—as much as 20% in some cases. Existing facilities can meet this demand without additional capital investment to the enterprise by improving OEE to increase production by 2% per facility.

OEE: THE 1% RULE

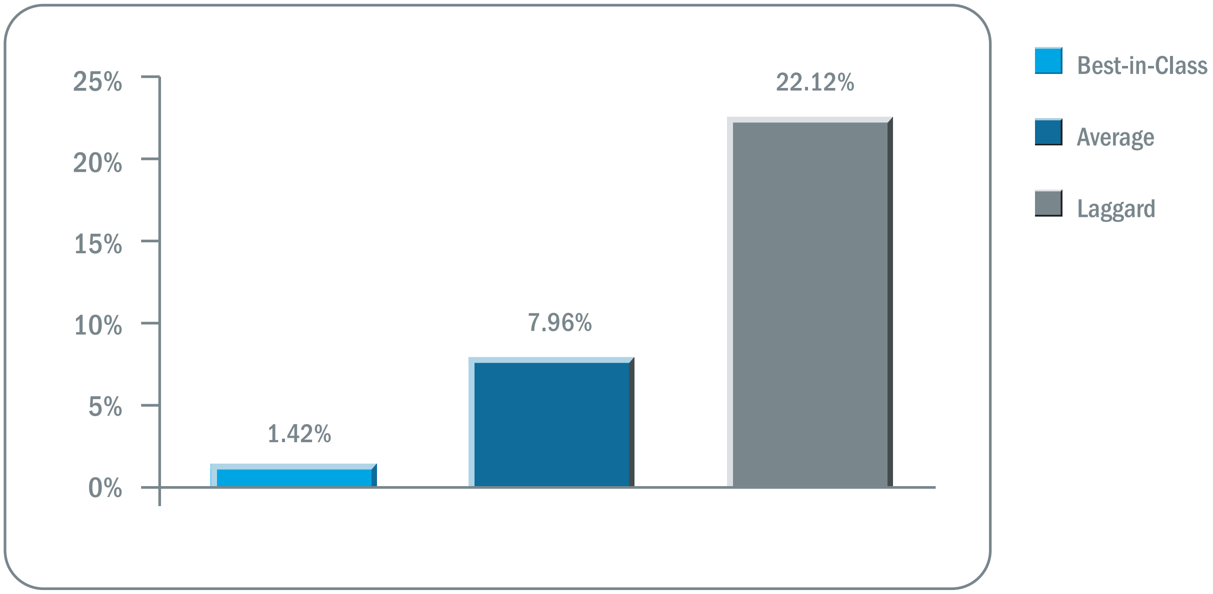
As we continue the journey exploring best-in-class differentiators, it's important to understand why so many organizations focus on OEE as a fundamental indicator of performance. Most of the manufacturers we studied are capacity constrained—producing more product equals more revenue.

While top-line revenue objectives typically drive initiatives to improve OEE, bottom-line benefits present strong justification for these efforts. A one-billion dollar manufacturer quantified the financial effect for each percentage point improvement in OEE as at least $6.5 million. The "one percent rule" creates value contribution in areas like cost of goods sold, inventory, gross profit, revenue, capital expense and assets.

Understanding capacity is perhaps one of the top characteristics of best-in-class performers. Accurate and consistent collection of operational data forms the foundation of continuous improvement initiatives. It also provides management information in order to take action—"the more I know, the more I can do something about it." Unidentified downtime and unknown reasons for downtime are two culprits of significant operating loss (see Chart 3: Undefined Downtime below).

Laggard manufacturers have 16 times more unidentified downtime than best-in-class performers. During a typical work week of 120 hours, this translates to the difference between 25.3 hours of unidentified downtime for laggards, versus only 1.7 hours for best-in-class (see Table 1: Downtime

CHART 3: UNDEFINED DOWNTIME



'BIG SIX' LOSSES IDENTIFIED

For this study, researchers categorized downtime in standard capacity loss buckets, known as the "Big Six," popular among most Total Productive Maintenance practitioners (see Table 3: Definition of "Big Six" Losses below). During the course of the study, researchers were able to further categorize operational downtime as major downtime and minor downtime—effectively turning the "Big Six" into the "Big Seven" (see Table 4: Total Big Six Losses on opposite page).

To show best-in-class, average and laggard behaviors through Key Performance Indicators, we depict the Big Six as a plot of loss values in a line graph. As we look to the intersection points and gaps, we can begin to understand differentiators and draw conclusions about what best-in-class performers do to achieve top OEE, and where laggards can find opportunities to improve OEE (see Chart 5: Big Six Losses on opposite page).

In the area of shutdown losses, there is a marked gap between best-in-class performers and their average counterparts, and a slight gap between average performers and their laggard counterparts. This trend suggests that best-in-class companies (those that excel in OEE) have a strong focus on reducing loss due to shutdown.

Interestingly, average performers experience greater loss due to major and minor downtime versus their laggard counterparts. This means that laggard performers are actually better at mitigating this type

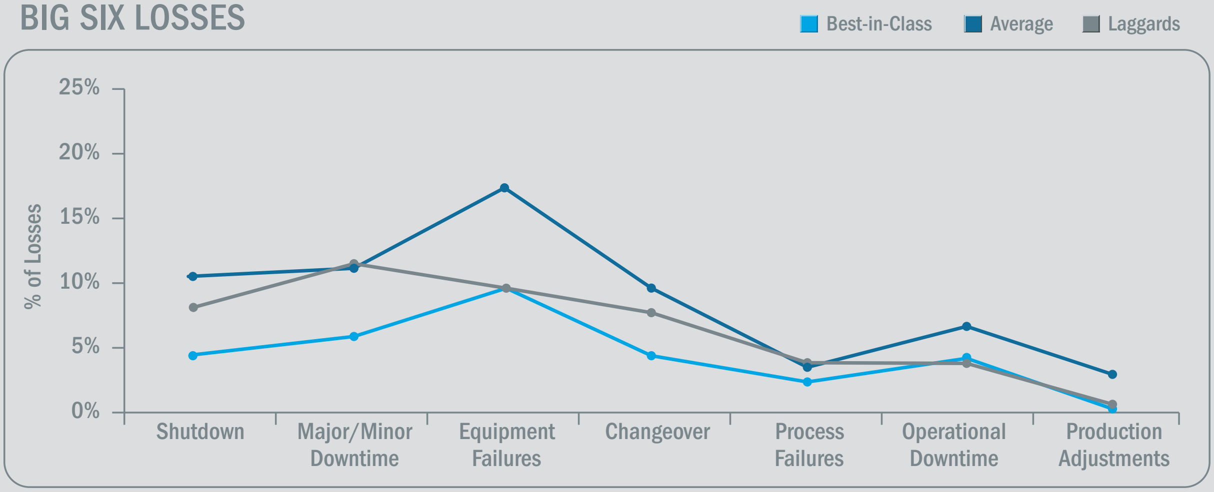
TABLE 3:
DEFINITION OF "BIG SIX" LOSSES

LOSS AREA	DESCRIPTION
1. Shutdown	Preventive maintenance, breaks and lunches, training exercises, other miscellaneous production stops
2. Operational Downtime	Adjustments or related equipment losses that are not direct failures during scheduled run time Major downtime >10 minutes Minor downtime <10 minutes
3. Changeover	Changes in material, equipment or product
4. Equipment Failures	Equipment unexpectedly becomes dysfunctional or inoperable
5. Process Failures	Changes in defective raw material
6. Production Adjustments	Time spent on changes in supply and demand that require adjustments to production plans

TABLE 4:
TOTAL BIG SIX LOSSES

	BEST-IN-CLASS	AVERAGE	LAGGARD
Shutdown	4.4%	8.4%	10.2%
Operational Downtime	4.4%	4.2%	6.8%
Major/Minor Downtime	5.9%	11.8%	11.1%
Changeover	4.4%	7.3%	9.2%
Equipment Failures	9.4%	9.4%	17.0%
Process Failures	2.3%	3.9%	3.8%
Production Adjustment	0.2%	0.5%	2.9%
Total	**30.8%**	**45.5%**	**61.0%**

CHART 5:
BIG SIX LOSSES



of loss. However, there is a significant gap by best-in-class manufacturers, suggesting this is a major area of focus that supports high OEE achievement.

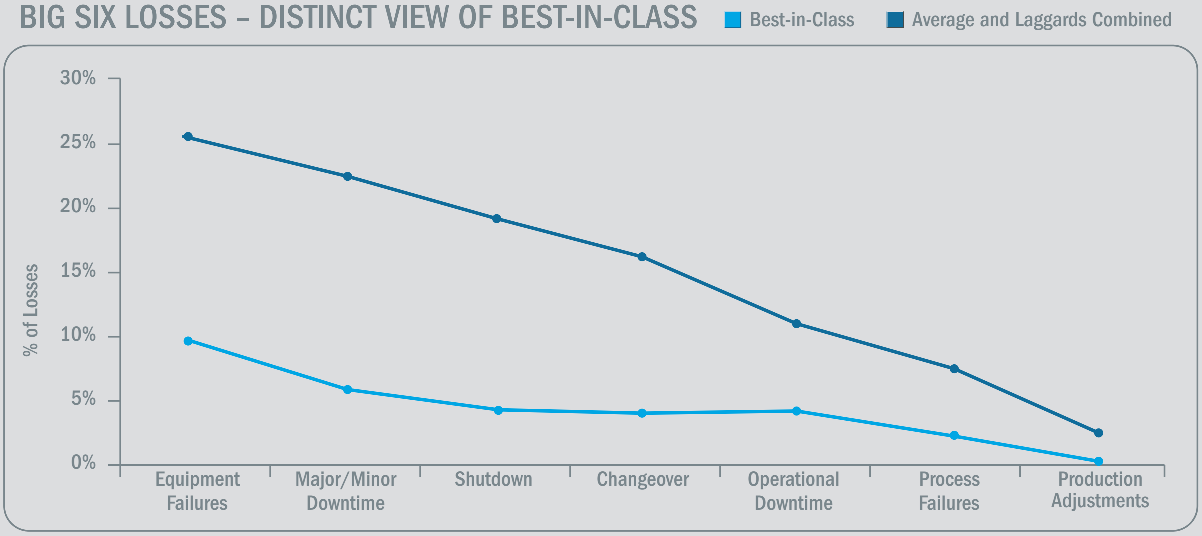
We notice an intersection of best-in-class and average manufacturers in equipment failures, with a large gap between them and the laggard group. This suggests a strong correlation between equipment failures and poor OEE.

There is a fairly linear relationship among best-in-class, average and laggard groups in the area of changeover

Analysis on opposite page). In other words, laggards lose more than a day of production and don't know it, or don't know why—compared to only a fraction of a day lost by best-in-class manufacturers.

Loss due to changeovers represents an important component to understanding the "Big Six" losses (see "'Big Six' losses identified" on p.8). A close examination of the issues surrounding changeover loss reveals a

CHART 6:
BIG SIX LOSSES – DISTINCT VIEW OF BEST-IN-CLASS



loss—somewhat of a mirror to the gaps in OEE.

Another area of focus by best-in-class performers is in maintaining low loss due to process failures. Since there is an intersection between average and laggard groups for this category, there exists opportunity for improvement for both groups.

Finally, best-in-class and average performers intersect in operational downtime and production adjustments, exposing two additional areas of opportunity for laggard manufacturers. Again, this intersection represents the fact that best-in-class and average exhibit similar performance, outpacing the laggards.

We created a second graph (see Chart 6: Big Six Losses—Distinct View of Best-in-Class above) to clearly highlight the disparity between best-in-class performers and all others (average and laggard combined). This provides clear distinction and a roadmap for those that aspire to best-in-class.

Average and laggard performers can use this as a starting point to understand which of the Big Six areas to focus on—starting with the largest gap (equipment failures) and progressing down the curve (such as major/minor downtime).

TABLE 1: DOWNTIME ANALYSIS

	BEST-IN-CLASS	LAGGARDS
Total Production Hours Per Week	120	120
Unknown Downtime	1.42%	22.10%
Hours Lost to Unknown	1.7	25.3

correlation to the average production run length (in hours). An attribute of best-in-class performers, based on the data, is shorter run length. In addition to the percentage of time lost from changeover, the actual length of time (on average) for changeover is an indication that best-in-class performers place a strong emphasis on reducing changeover and is a major contributor to OEE performance (see Table 2: Changeovers below).

We define minor stops as interruptions lasting 10 minutes or less. The minor stop index is the number of minor stops per hour. Laggard CPG manufacturers exhibit a minor stop index 2.1 times over best-in-class manufacturers (3.7 minor stops per hour versus 7.9)—a value that mirrors the gap in OEE performance (see Chart 4: Minor Stops Per Hour on p.13). Our study revealed that the average packaging line has more than 2,000 interruptions per month.

RECOMMENDATIONS AND NEXT STEPS

Throughout the analysis, we used one metric, OEE, to show which metrics correlate to best-in-class performance—a one-to-many map. To develop recommendations, we turned this upside down with a many-to-one map. While average and laggard manufacturers may have a distance to travel to approach ▸

TABLE 2: CHANGEOVERS

	BEST-IN-CLASS	AVERAGE	LAGGARD
Average Length of Run	6.65 hours	9.04 hours	9.1 hours
% Time Lost From Changeover	4.35%	7.34%	9.19%
Average Length of Changeover	17 minutes	40 minutes	50 minutes

Top performing companies view operational excellence as a discipline starting at the highest levels of the organization.

best-in-class performance, even current best-in-class performers have room to improve. With an average OEE of 70%, the highest OEE in this study was 85%—clearly the best-of-the-best. Everyone can take steps right now to have an impact on performance:

- Measure operations with more levels of detail—unknown downtime is staggering—22.12% for laggards versus 1.42% for best-in-class. Laggard performance clearly epitomizes the cliché "you cannot manage what you cannot measure."
- Put the gap principle into action—develop a priority list of loss areas to investigate. We suggest tackling equipment failures, major/minor downtime, shutdown and changeover, in order.
- Review changeover processes more carefully.
- Revisit production run lengths—with the significant gap between best-in-class and laggards, it's a worthwhile area to explore for possible contribution to OEE.

ABOUT INFORMANCE BENCHMARK STUDIES

Informance benchmark studies demonstrate how practices of best-in-class companies impact manufacturing performance. Researchers use five to seven months of real-time manufacturing performance data aggregated using the Informance Enterprise Manufacturing Intelligence platform.

The highly granular and rich real-time nature of Informance EMI adds a new dimension for external and internal benchmarking initiatives. By correlating attributes of best-in-class performers across a variety of metrics, executives have the ability to gain insight and direction. Organizations can use Informance benchmark studies as a starting point to understand how they stack up against their peers and develop an action plan for operational improvement.

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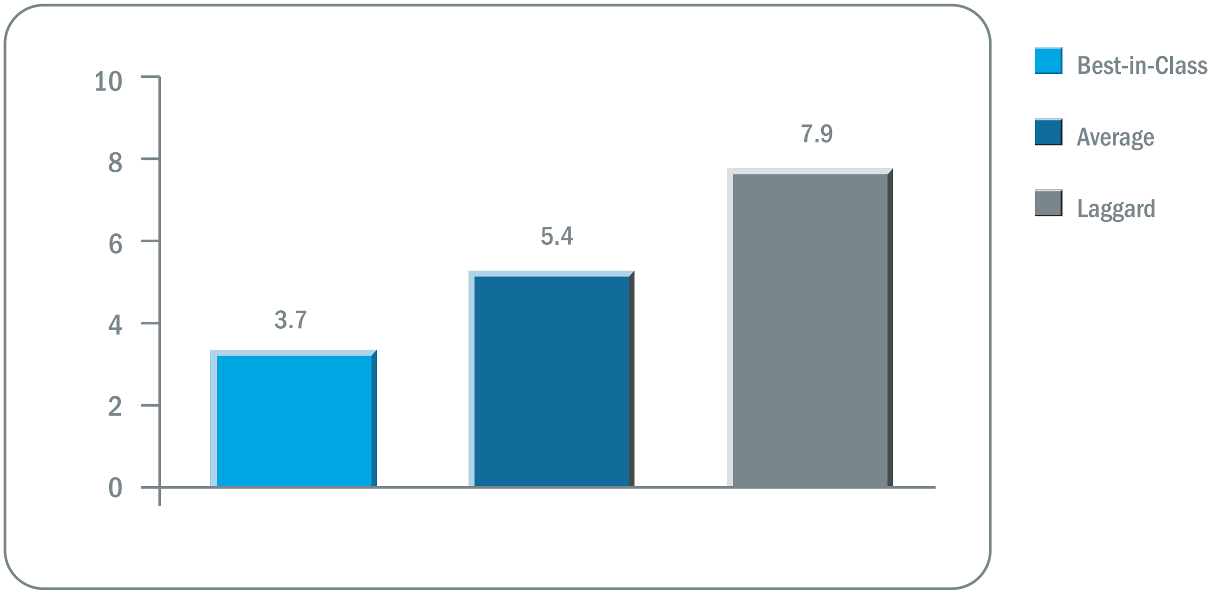
CHART 4:
MINOR STOPS PER HOUR



While our research was quantitative, we discovered interesting anomalies among the businesses we studied. Top performing companies view operational excellence as a discipline starting at the highest levels of the organization and can share information, knowledge and best practices among plants. These initiatives include individuals at all levels throughout the organization and foster adoption of operational excellence principles at all levels.

Organizations are now turning to multi-plant or cross-plant analysis to leverage improvement gains. By viewing operational KPIs across the business, in multiple dimensions, companies can make more intelligent decisions. Some multi-dimension KPIs include OEE by stock-keeping unit (SKU), by customer, by plant and even by customer order. For example, these kinds of metrics can enable a true understanding of the impact of a customer's orders on operations, or which are the top- and bottom-performing SKUs.

In the final analysis, there is a growing trend toward using multi-dimension operational metrics to make decisions that affect operational objectives. **F&BP**

Sudy Bharadwaj has nearly 20 years of business process leadership. Prior to Informance International, he was senior analyst and vice president of global supply management research programs for Aberdeen Group. Before that, Sudy was a member of the management team of MINDFLOW Technologies, a leading strategic sourcing solutions provider. He has also served in a variety of management roles spanning marketing, sales, product management, program management and consulting.

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